Climate Change Adaptation:
lessons from global practice relevant to Alaska

Ian M. Dutton
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Alaska SeaLife Center
windows to the sea

Climate Change Adaptation Workshop
Kachemak Bay Research Reserve
Homer 18th February, 2010

Why we need to adapt in new ways to new challenges faster than ever before

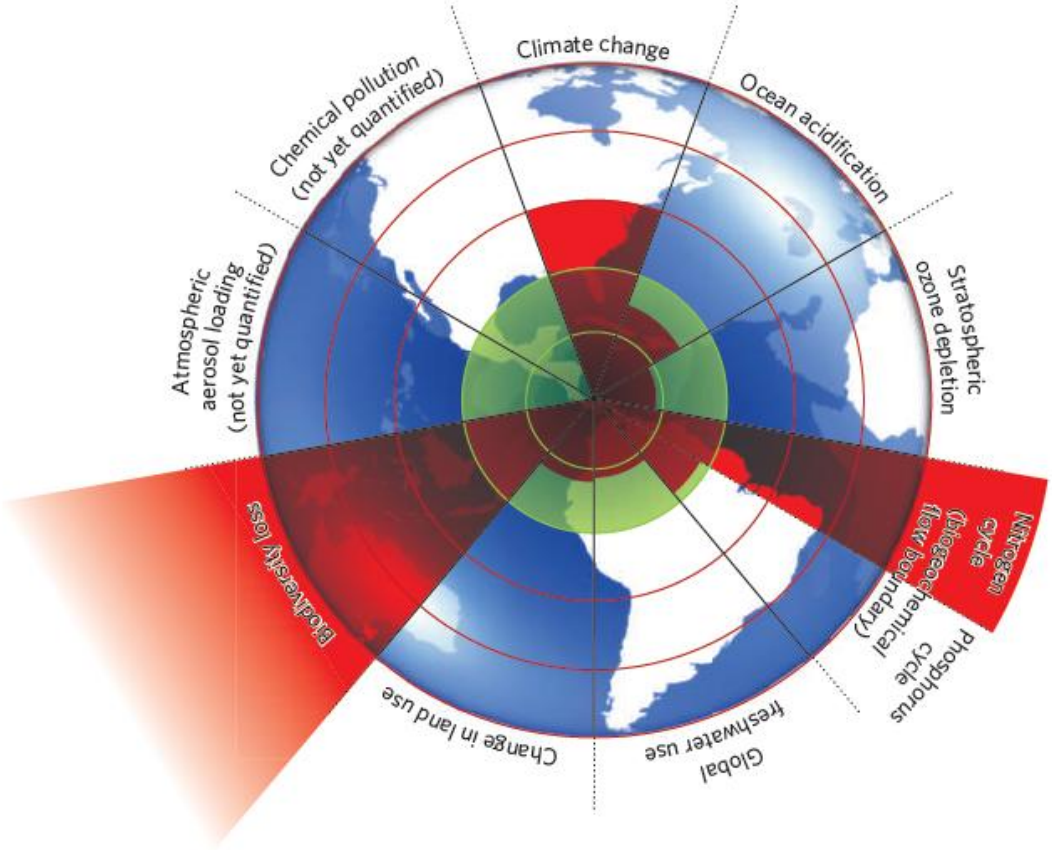


Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.

Rockstrom et al. 2009 Nature 461 September, 2009.
http://tinyurl.com/planetboundaries.

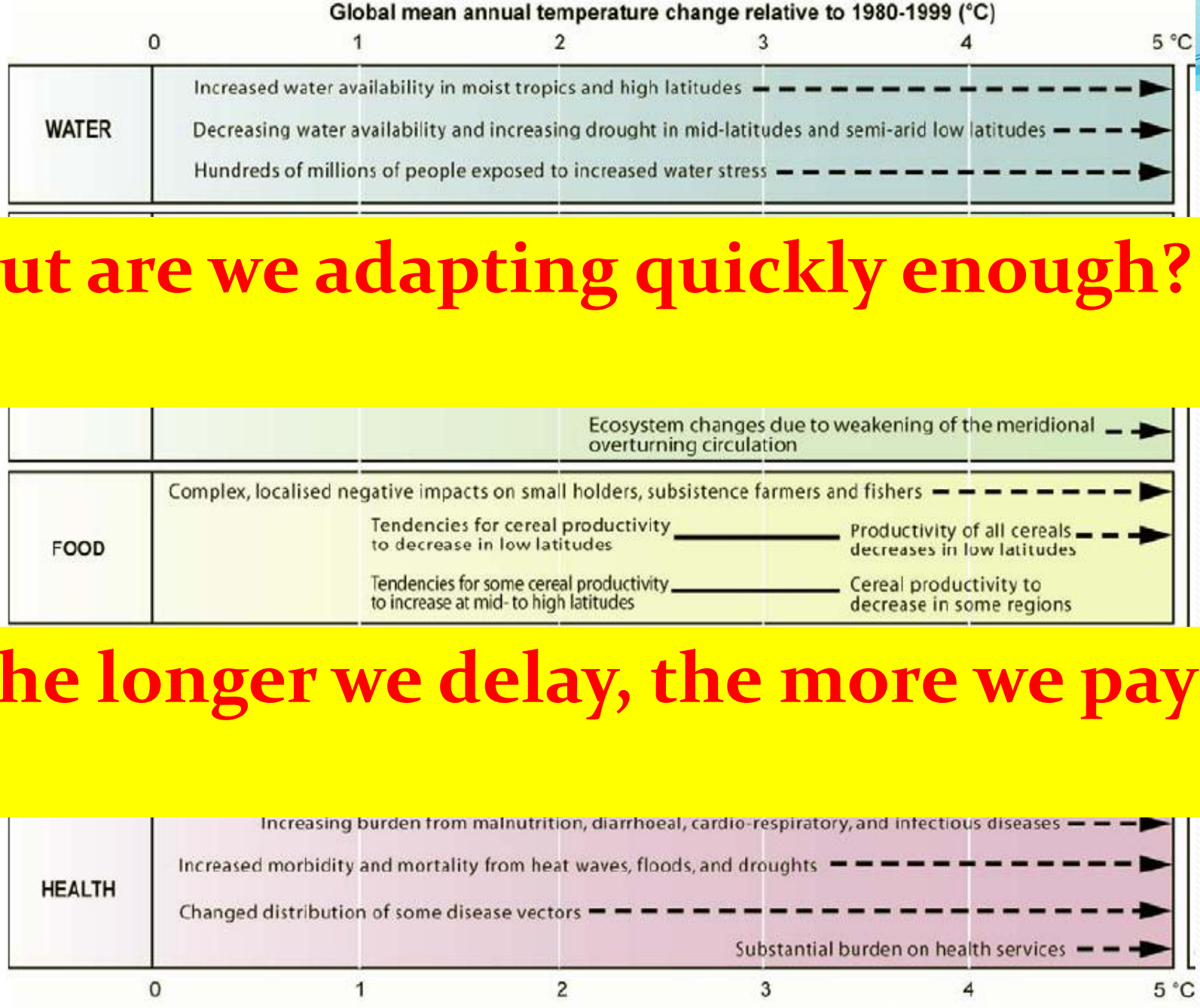
And why it is hard to move forward…

I fear that scepticism of climate change by some pro-development councillors will place more and more properties and infrastructure in hazardous locations, or allow acceptance of building designs that will be unsustainable as temperatures rise and water supplies dwindle.

Prof. Bruce Thom, Member, Wentworth Group of Concerned Scientists, 2007

There is hope

http://www.climatechange.alaska.gov/docs/Hartig_COP-15_11Dec09.pdf



But are we adapting quickly enough?

The longer we delay, the more we pay

http://www.planning.nsw.gov.au/

Overview

An Adaptation Learning Journey – then and now

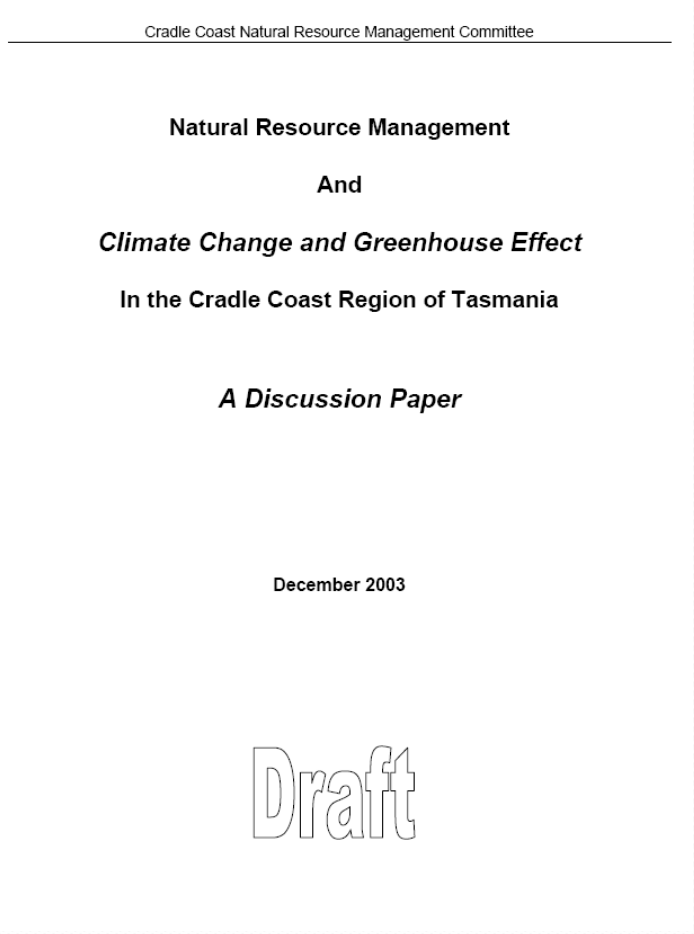
- Growing up on an island
- Working (and living) on the coast
- Working in developing countries where healthy people depend on healthy ecosystems
- Coping with global change – strategies to promote resilience and adaptation in Indonesia and the Pacific
- Emerging principles and knowledge networks
- Three key recommendations

Initial Exposure 1: Devonport City

Late 1980s – refused coastal subdivision permit on basis of anticipated sea level rise!

Cradle Coast NRM Climate Strategy

http://www.nrmtas.org/library/cradle/documents/ClimateChangeandGreenhouseEffect.pdf



Cradle Coast Natural Resource Management Committee

Natural Resource Management

And

Climate Change and Greenhouse Effect

In the Cradle Coast Region of Tasmania

A Discussion Paper

December 2003

Draft

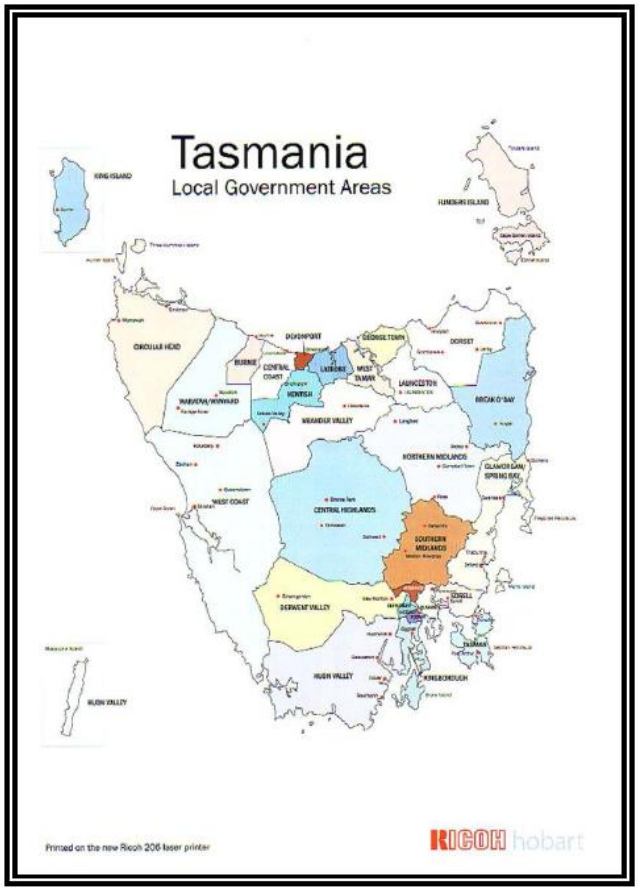
Regional Priority: Climate Change and Greenhouse

Regional Goals:

- To limit net greenhouse gas emissions, in particular to meet international commitments.
- To foster knowledge and understanding of greenhouse issues.
- To lay the foundations for adaptation to climate change.
- Develop appropriate planning and development policies and improve information access for suitable management of climate change effects.
- To capitalise on agricultural opportunities for Primary Industries.

Tasmania CC Initiatives by Local Government 2008

http://www.lgat.tas.gov.au/webdata/resources/files/LG_CC_Initiatives_Survey_Oct_2008.pdf



Hobart City Council

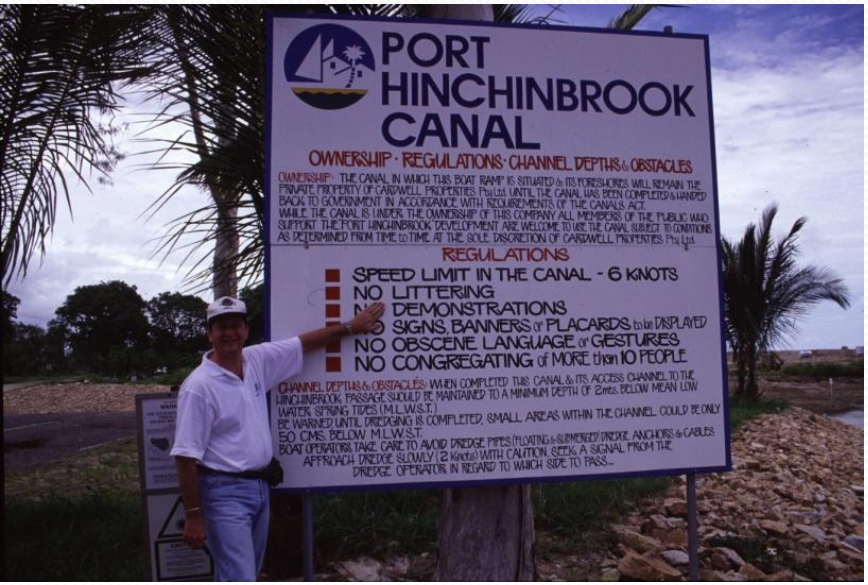
Dedicated Officer	Please include projects and programs being undertaken both internally and out sourced (consultants, NRM Regions and Regional Bodies)	Please provide a brief outline of the project.	Contact person including name, email and phone
YES	1. Climate Adaptation Team. 2. Energy Reserve Fund. 3. Beat the Winter Chills and Bills. 4. Street lighting trial. 5. Climate Futures Tasmania – Infrastructure. 6. Cities for Climate Protection.	1. HCC is establishing a Climate Adaptation Team to implement as appropriate the CCP Local Government Climate Adaptation Toolkit and Climate Change Adaptation Actions for Local Government AGO 2007. 2. Establishment of Energy Reserve Fund $50,000 pa for projects not covered by other budget processes. 3. Question and Answer Sessions and Display HCC engaged SLT to deliver a series of 6 x BWCB Sessions to assist householders to improve their energy efficiency, increase understanding of climate change and action by HCC, and begin to build community resilience. A further 4 Q&A sessions held for Council staff and aldermen focusing on both the household and workplace actions. 4. HCC, in conjunction with Aurora is undertaking a small scale trial of street lighting (T5 and CFL's) to commence 28.08.08 at Poets Rd T5 (48) and Princes St's CFL's (42). Will run for 12 – 18 mths – to account for climate factors and survey residents. 5. Contributing partner to project coordinated by Pitt and Sherry. 6. CCP PLUS, Emissions inventory, Annual inventory of emissions corporate, Census year inventory of emissions community.	Katrina Graham 6267 4240 grahamk@hobartcity.com.au

King Island Council

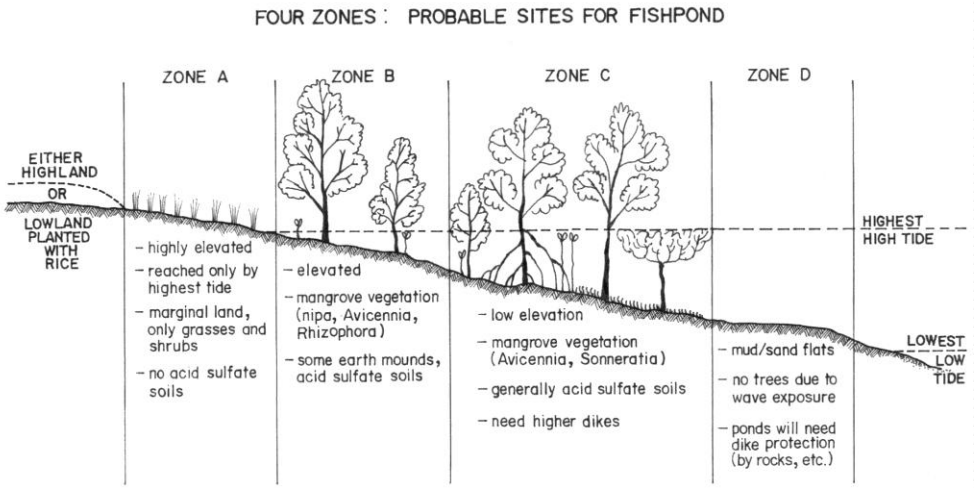
Dedicated Officer	Please include projects and programs being undertaken both internally and out sourced (consultants, NRM Regions and Regional Bodies)	Please provide a brief outline of the project	Contact person including name, email and phone
YES			Douglas Burke 6462 1177 dburke@kingisland.net.au
	Clean Biz (State initiative) Village Green (consultants)		Karen Taplin 6462 1177 ktaplin@kingisland.net.au
	Investigation of 'green' alternatives to diesel for power generation by Hydro		Karen Taplin 6462 1177 ktaplin@kingisland.net.au
	Investigation into reduction of greenhouse gases generated on the Island		Jenny Thorn 6462 1177 economic@kingisland.net.au
	Local Adaptation Pathways		Charles Arnold 6462 1721 charles.arnold@bigpond.com

Initial Exposure 2: Coastal Systems

Mangrove Valuation



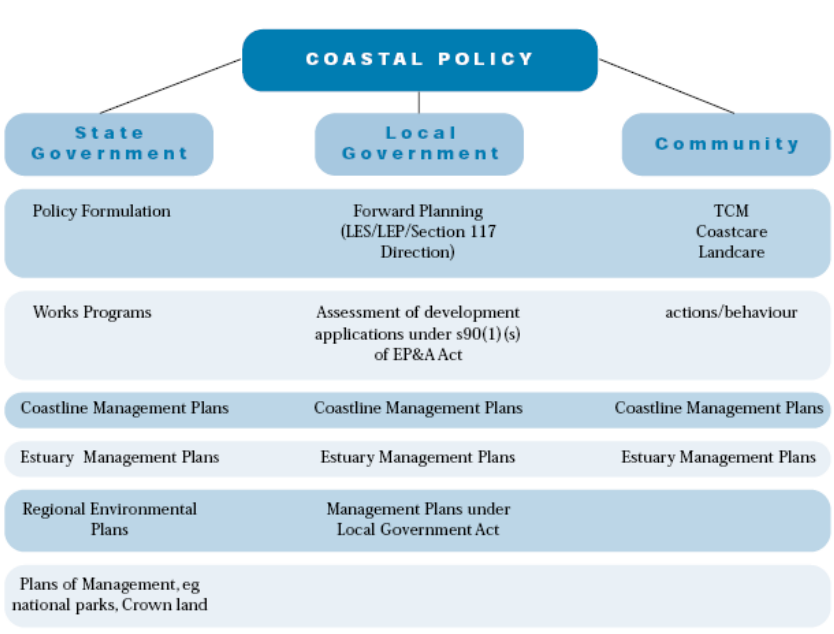
Adaptation Space?



Inputs to Coastal Policy

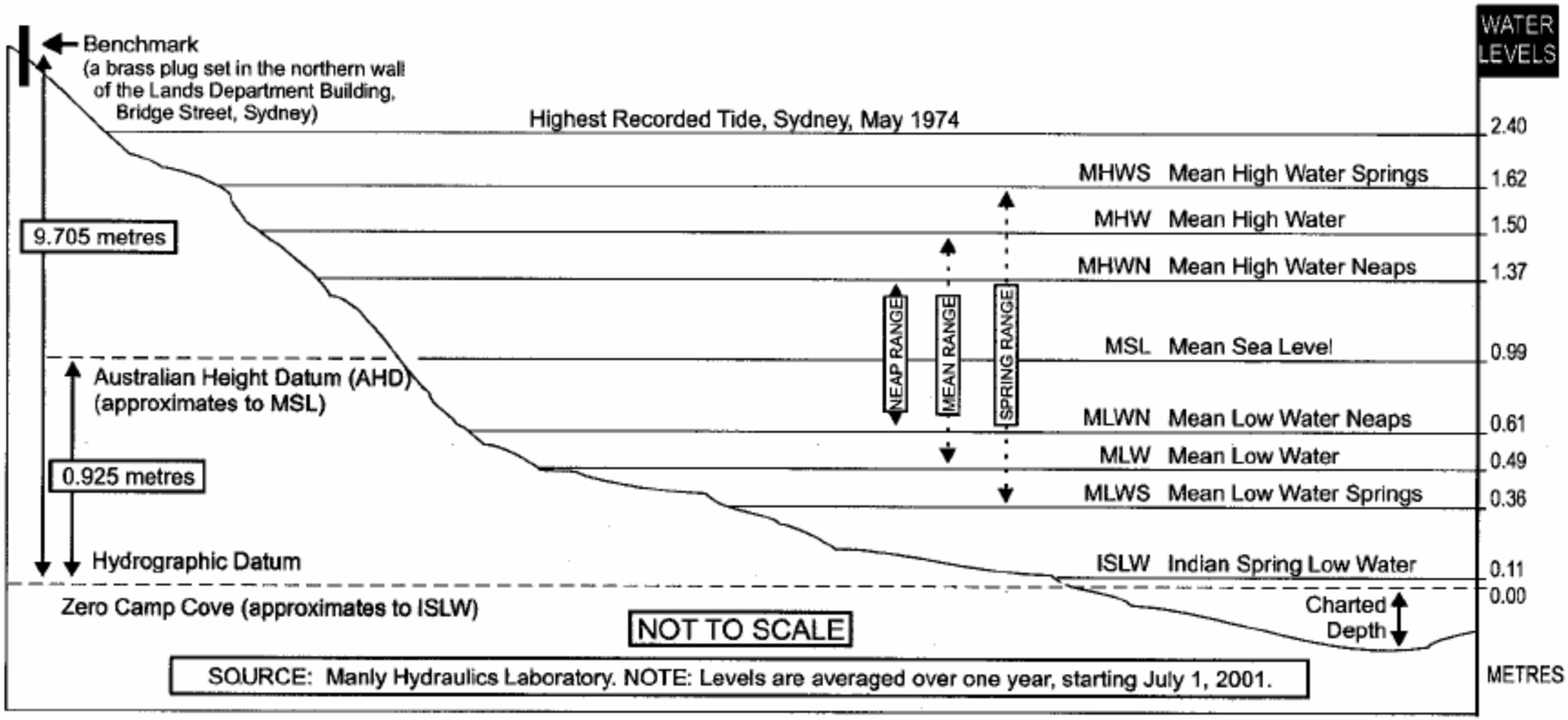
NSW Coastal Policy 1997

- Investigations and monitoring of climate change for coastal areas will continue and sea level rise scenarios will be incorporated into management plans and other mechanisms, where appropriate.



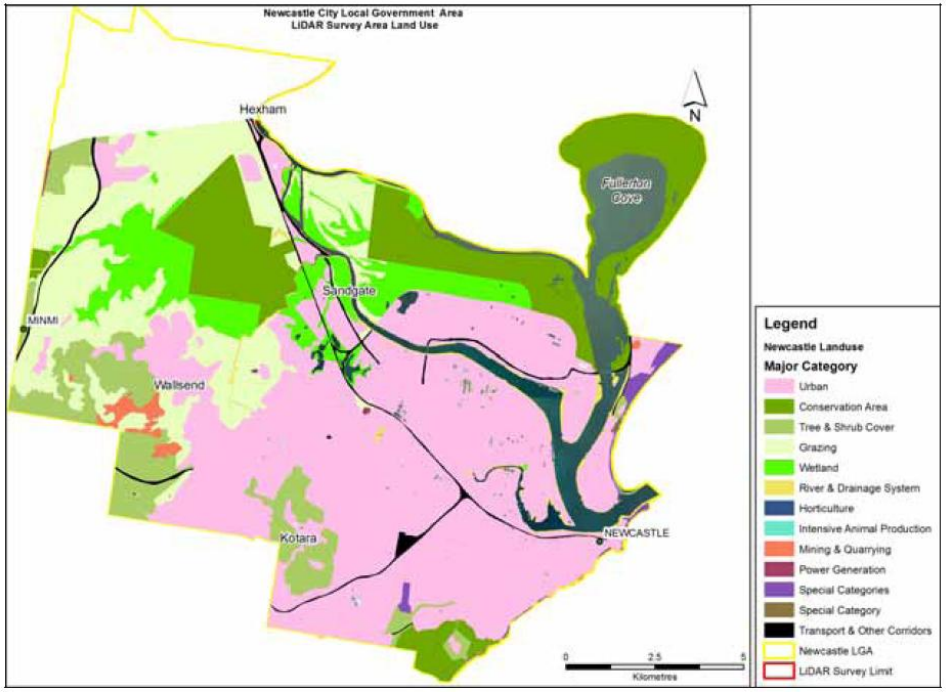
SLR – where are we starting from?

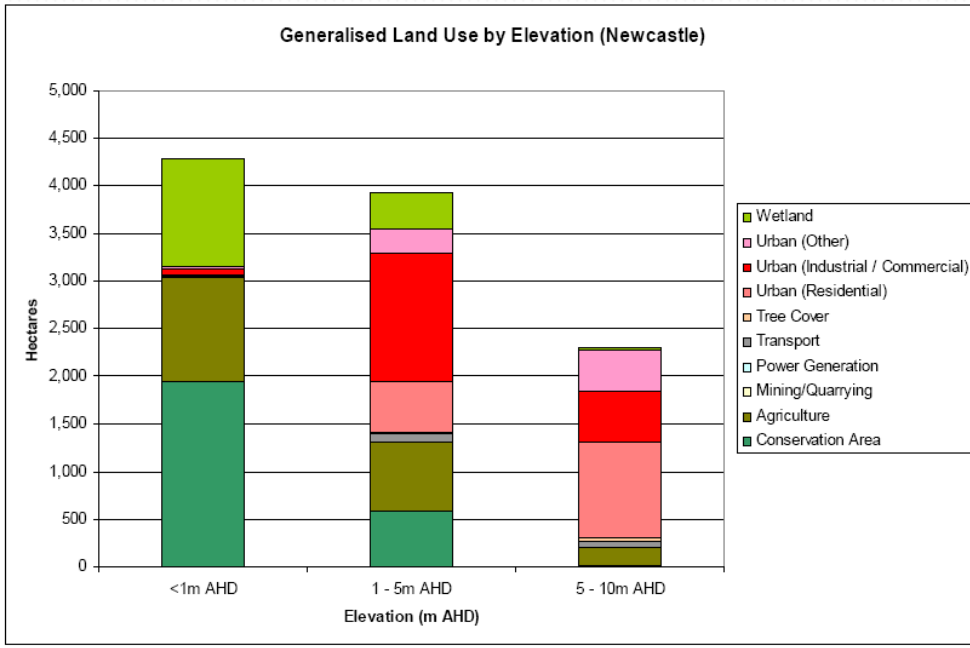
http://www.planning.nsw.gov.au/plansforaction/pdf/terrainmapping_central_hunter_coasts_report.pdf



Coastal Planning Implications of SLR

http://www.planning.nsw.gov.au/PlansforAction/Coastalprotection/ClimateChangeMappingProject/





LiDAR (Light Detection and Ranging) aerial survey 2008

- 0.15m vertical accuracy, 0.6m horizontal accuracy, data collected +/- 2 hours of low tide
- Survey cost = $250,000; data publicly available

Initial Exposure 3: Indonesian Islands

Coastal Ecosystems

Economic Adaptation

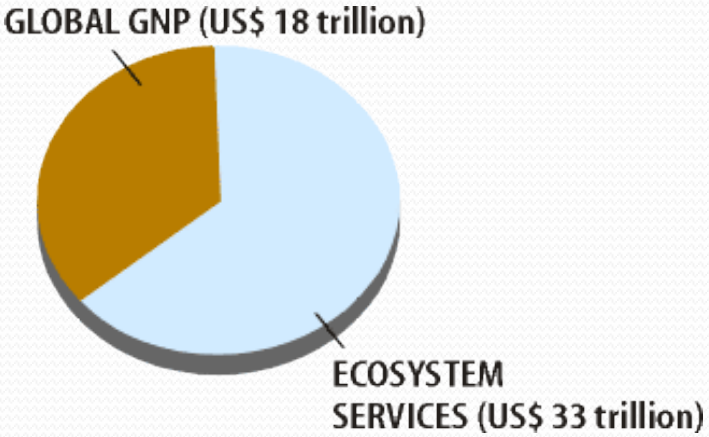
Promoting Resilience

Improving Governance

Engaging Stakeholders

http://www.crc.uri.edu/download/2000_Dahuri_CP_Integrated_Coastal_Marine.pdf

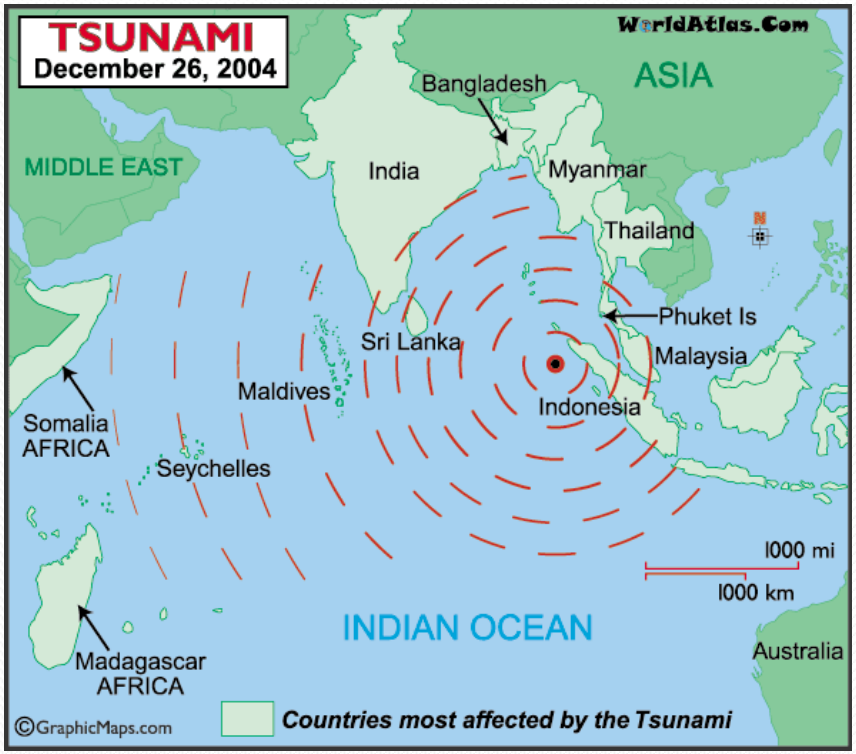
Ocean Values



Direct and Indirect Services	Estuaries and Marshes	Mangroves	Lagoons and Salt Ponds	Intertidal	Kelp	Rock and Shell Reefs	Seagrass	Coral Reefs
Food	●	●	•	●	•	●	•	●
Fiber, timber, fuel	●	●	●					
Medicines, other	•	•	•		●			•
Biodiversity	●	●	●	●	●	●	•	●
Biological regulation	●	●	●	•		•		•
Freshwater storage and retention	•		•					
Biochemical	•	•			•			•
Nutrient cycling and fertility	●	●	●	•	•	•		●
Hydrological	•		•					
Atmospheric and climate regulation	●	●	●	•		•	•	●
Human disease control	●	●	●	●		•	•	•
Waste processing	●	●	●			•	•	•
Flood/storm protection	•	●	•	•	•	•	•	●
Erosion control	•	●	•				•	•
Cultural and amenity	●	•	●	●	•	•	•	●
Recreational	●	•	•	●	•			●
Aesthetics	●	•	●	●				●

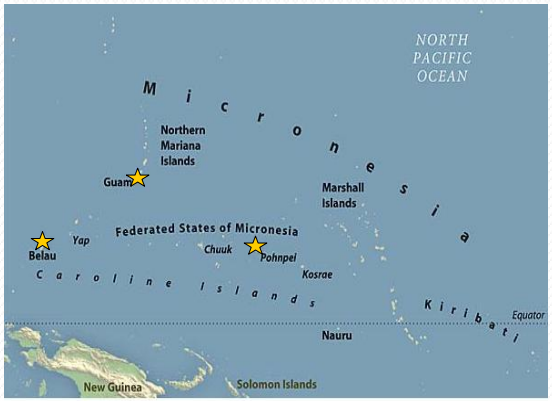
Source: R. Costanza *et al.*, "The Value of the World's Ecosystem Services and Natural Capital," *Nature* Vol. 387 (1997)

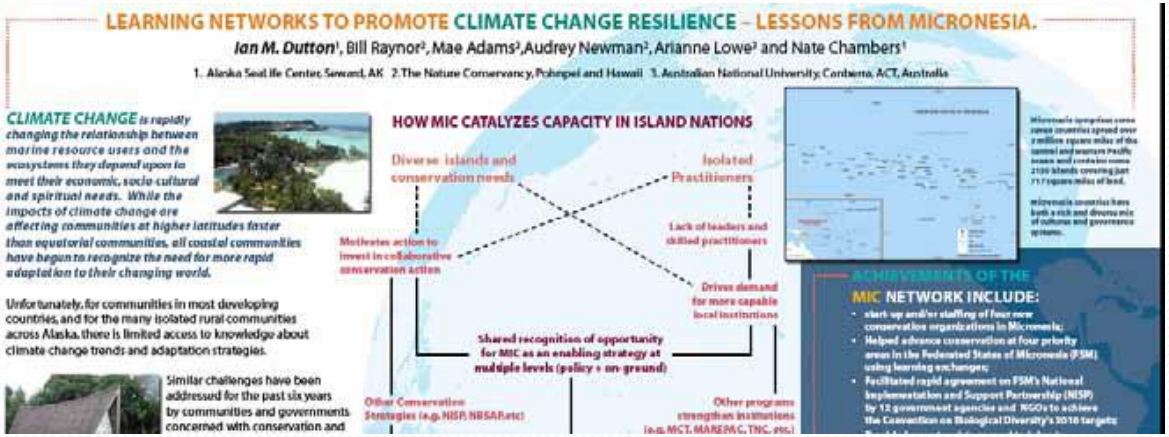
Recognizing Ecosystem Service Values



http://www.naturalcapitalproject.org/about.html

MIC Learning Network





LEARNING NETWORKS TO PROMOTE CLIMATE CHANGE RESILIENCE – LESSONS FROM MICRONESIA.

Ian M. Dutton[1], Bill Raynor[2], Mae Adams[2], Audrey Newman[2], Arianne Lowe[2] and Nate Chambers[1]

1. Alaska SeaLife Center, Seward, AK 2. The Nature Conservancy, Pohnpei and Hawaii 3. Australian National University, Canberra, ACT, Australia

CLIMATE CHANGE *is rapidly changing the relationship between marine resource users and the ecosystems they depend upon to meet their economic, socio-cultural and spiritual needs. While the impacts of climate change are affecting communities at higher latitudes faster than equatorial communities, all coastal communities have begun to recognize the need for more rapid adaptation to their changing world.*

Unfortunately, for communities in most developing countries, and for the many isolated rural communities across Alaska, there is limited access to knowledge about climate change trends and adaptation strategies.

Similar challenges have been addressed for the past six years by communities and governments concerned with conservation and

HOW MIC CATALYZES CAPACITY IN ISLAND NATIONS

Diverse islands and conservation needs

Isolated Practitioners

Lack of leaders and skilled practitioners

Motivates action to invest in collaborative conservation action

Drives demand for more capable local institutions

Shared recognition of opportunity for MIC as an enabling strategy at multiple levels (policy + on-ground)

Other Conservation Strategies (e.g. NISP, NBSAP, etc)

Other programs strengthen institutions (e.g. MCT, MAREMAC, TNC, etc.)

ACHIEVEMENTS OF THE MIC NETWORK INCLUDE:

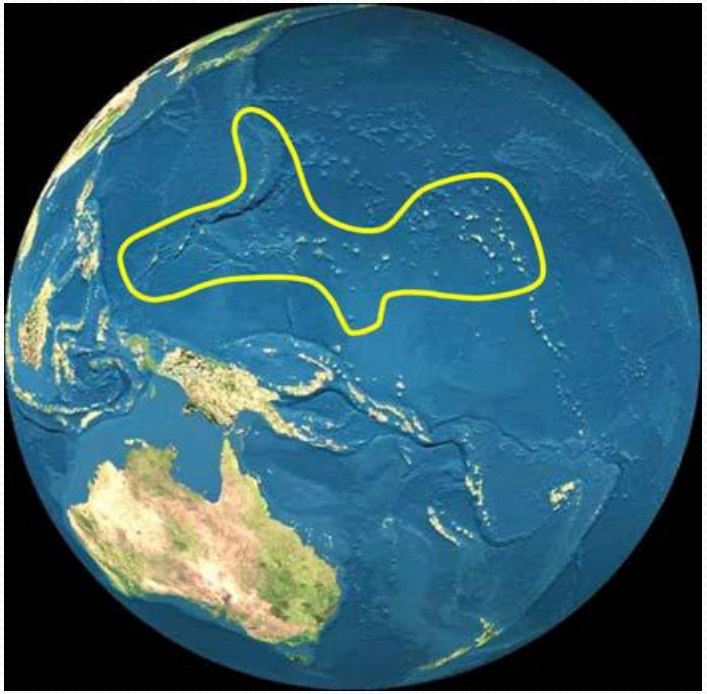
- start-up and/or staffing of four new conservation organizations in Micronesia;
- Helped advance conservation at four priority areas in the Federated States of Micronesia (FSM) using learning exchanges;
- Facilitated rapid agreement on FSM's National Implementation and Support Partnership (NISP) by 12 government agencies and NGOs to achieve the Convention on Biological Diversity's 2010 targets

Sustainability at Scale

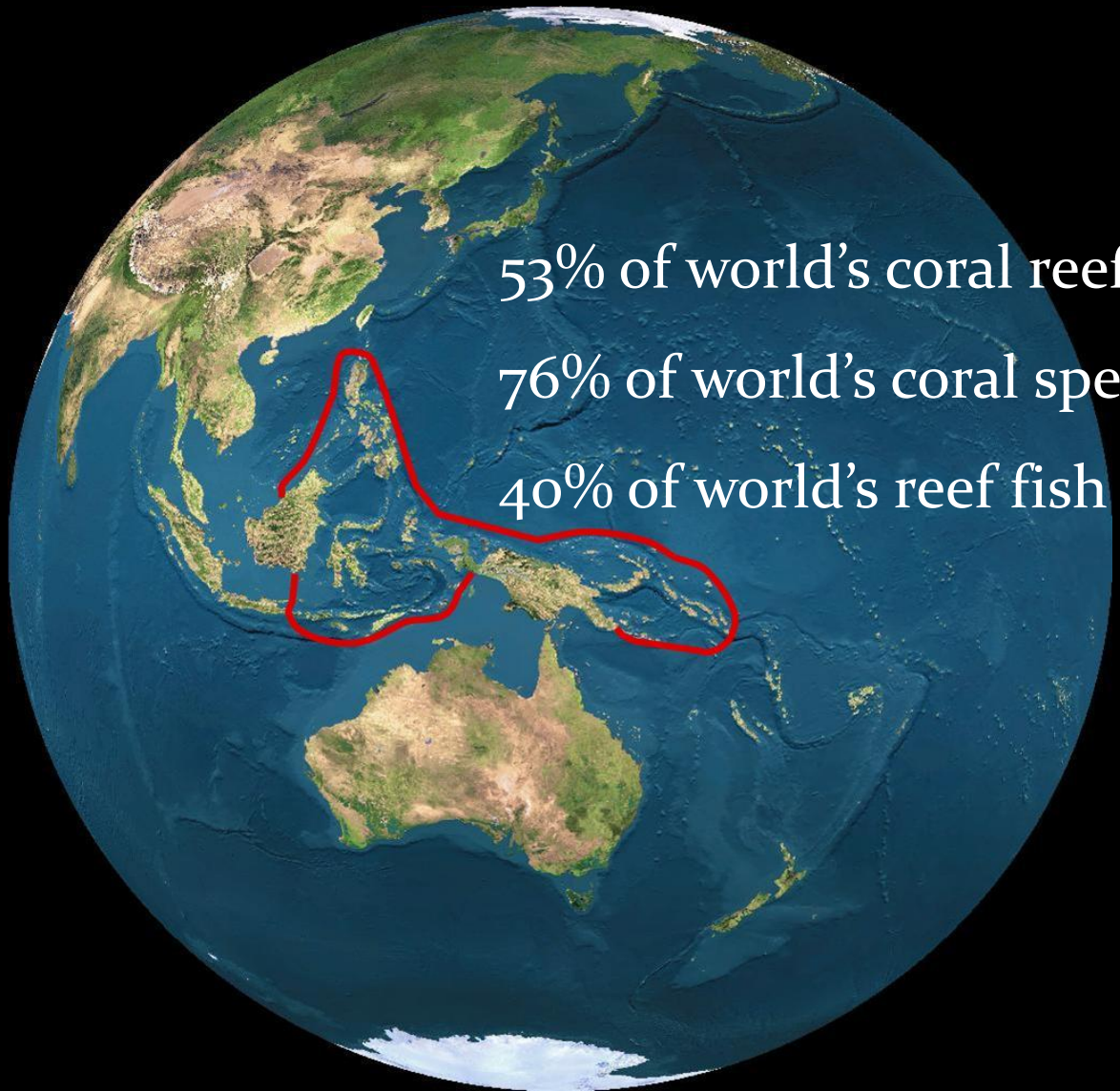
Micronesia Challenge is a commitment by the Federated States of Micronesia, the Republic of the Marshall Islands, the Republic of Palau, Guam, and the Commonwealth of the Northern Marianas Islands .

The overall goal of the Challenge is to effectively conserve at least 30% of the near-shore marine resources and 20% of the terrestrial resources across Micronesia by 2020.

http://micronesiachallenge.org/



Coral Triangle



53% of world's coral reefs

76% of world's coral species

40% of world's reef fish species

The Nature Conservancy
Protecting nature. Preserving life.™

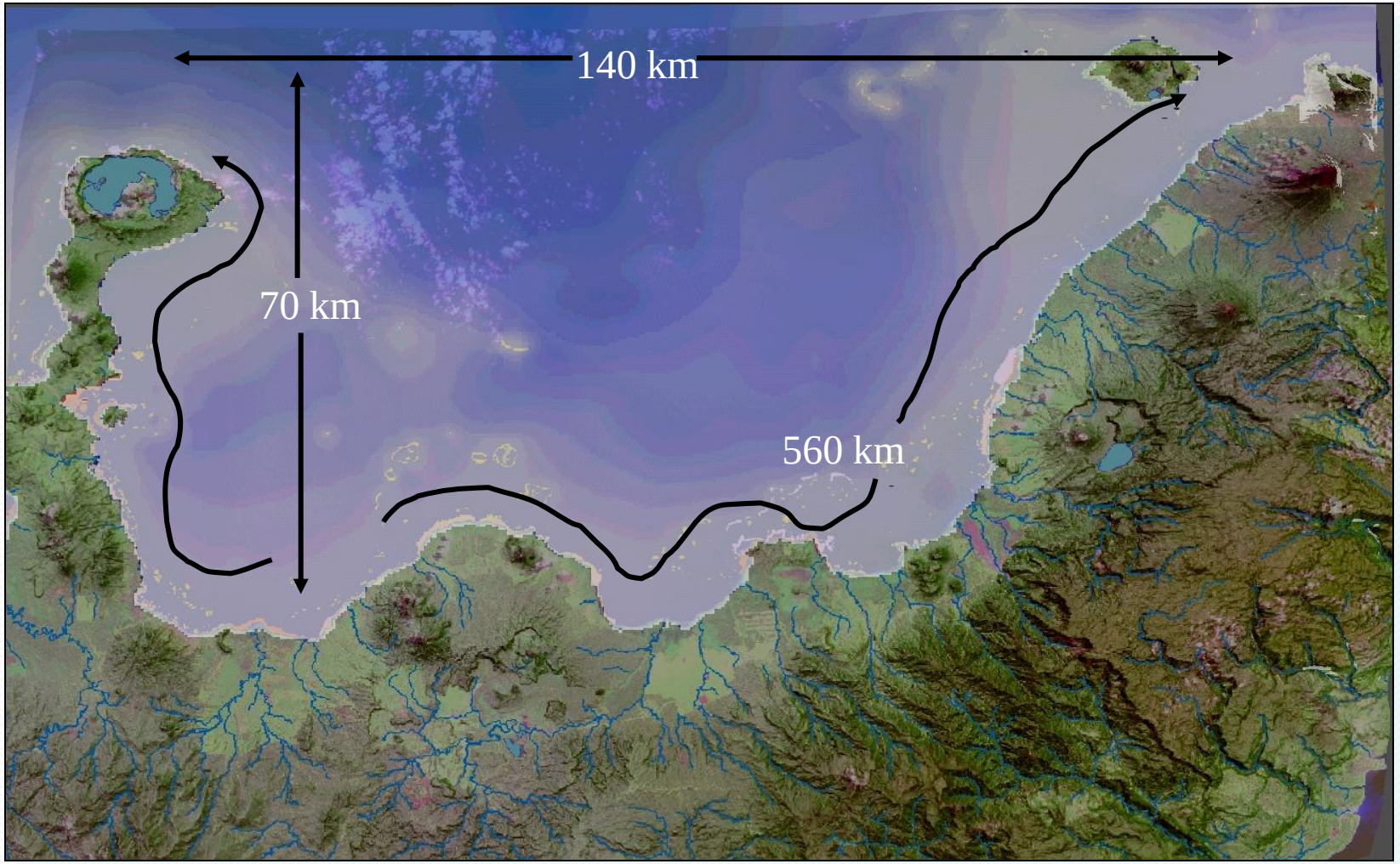
www.nature.org/mpapovertystudy

Coral Triangle Initiative: 2007-

http://www.uscti.org/

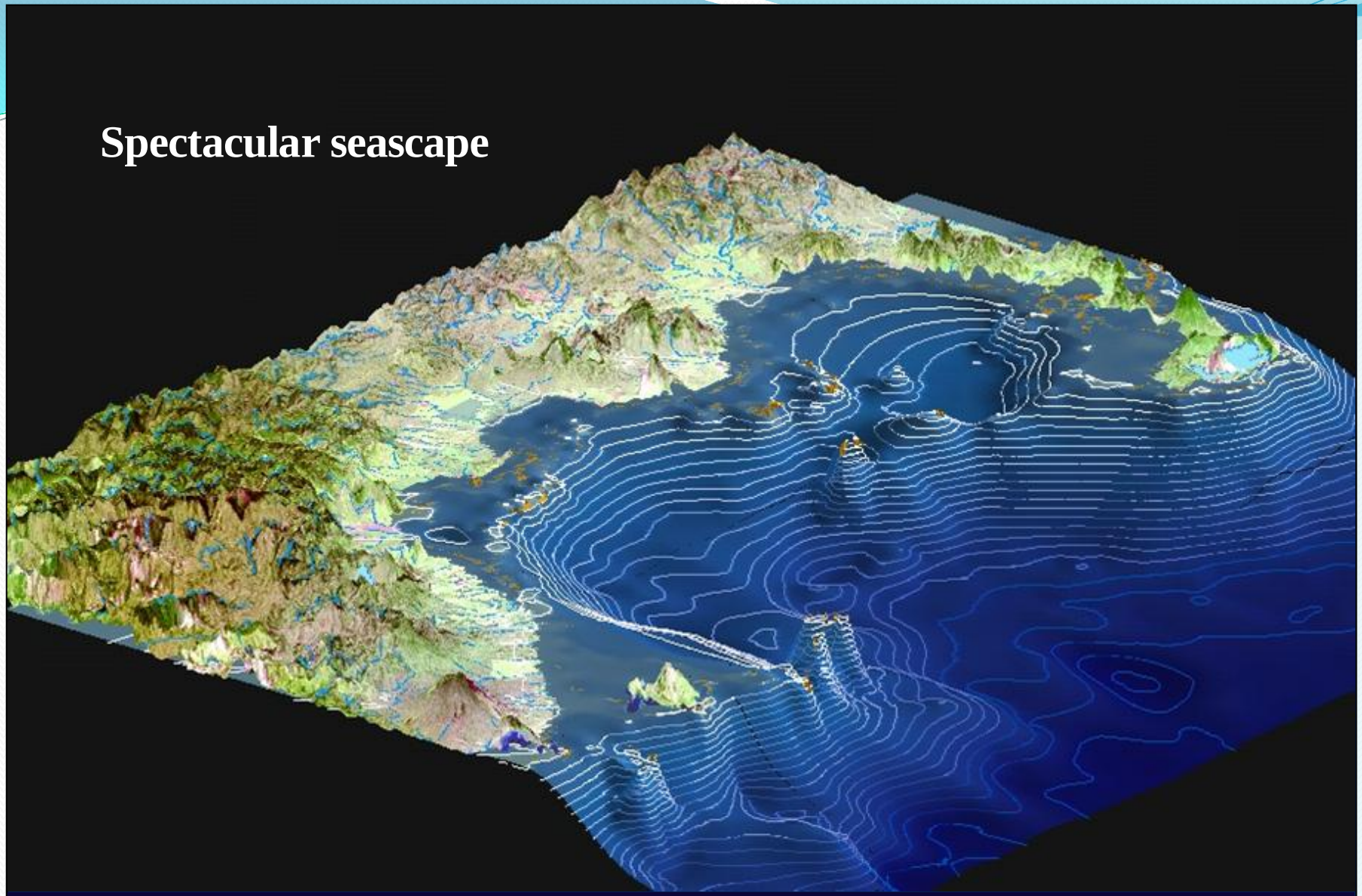
Solomon Islands MPA Network Design

Kimbe Bay MPA Network - Marxan Analysis



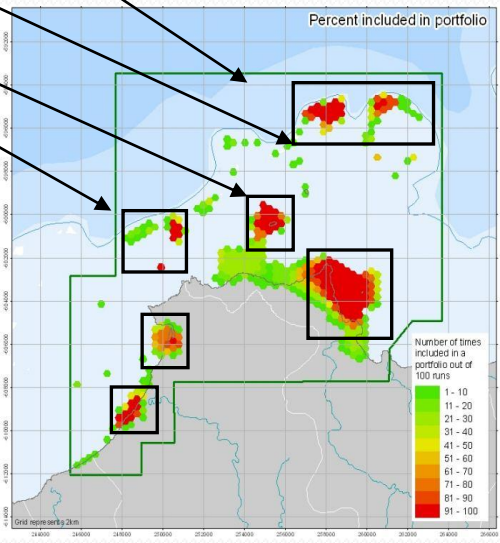
Green et al, 2009, Oryx

Spectacular seascape



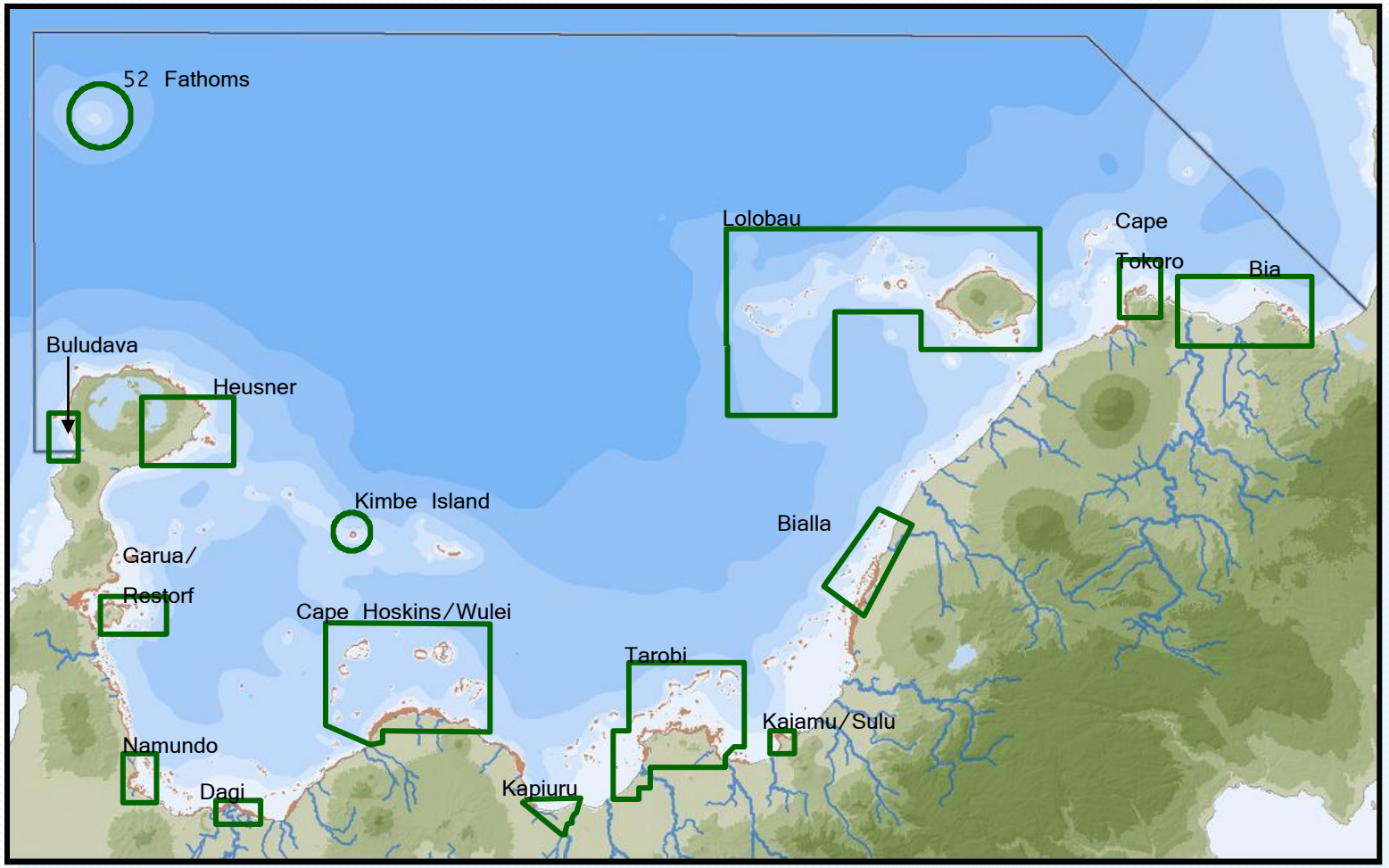
Coastal shelf (200m max), most >500m deep, narrow
Drops off dramatically to deep ocean depths (>2000m) close to sh ore

		Permitted (v) Not Permitted (X) Activities					
ZONE	Preservation	Marine Reserve	Buffer	Research	Habitat Protection	Conservation Zone	General Use
	NO GO	NO TAKE	LIMITED TAKE Pelagics Only	NO TAKE (EXCEPT WITH PERMIT)	PROTECTION OF HABITAT SOME TAKE	PROTECTION OF KEY FEATURES SOME TAKE	TAKE
Poison Rope Fishing	X	X	X	X	X	X	X
Spear Gun Fishing	X	X	X	X	X	X	v
Net fishing	X	X	X	X	X	X	v
Hook & Line Fishing	X	X	X	X	v	v	v
Night Fishing Using torch/lamp	X	X	X	X	X	X	v
Harvesting of Sea Cucumber & Trochus	X	X	X	X	X(C)	X	v Species restriction
Harvesting of Wild Fowl Birds & Eggs	X	X (A)	X (A)	X (A)	-	X	v
Harvesting of Turtle and Eggs	X	X (A)	X (A)	X (A)	X	X	v species restriction
Tourism (Diving & Photography)	X	X	X	X	v Permit	v Permit	v Permit
Recreational Picnic & Snorkeling	X	X	X	X	v Permit	v Permit	v
Boating	X	v (B)	v (B)	v (B)	v	v	v
Research (Diving Using Scuba)	X	v Permit	v Permit	v Permit	v Permit	v Permit	v Permit
Shipping	X	X	X	X	X	X	X
Commercial Fishing (Trochus, Sea Cucumber)	X	X	X	X	X	X	X
Cutting of Shoreline Trees	X	X	X	X	X	X	X



(A) Harvesting of turtle eggs and megapode eggs is restricted to Banban Island (This should be further restricted to a contrained collection time)
A is problematic as it is supposed to be a "No Take" area??
(B) Permit required for boating with the exception of Bulubulu to Tamabolo and Tagi reef
(C) Hook and line fishing NOT permitted with the exception of Tivogo and Veavea Bay
Species restrictions - What species?? Can the communities identify these??

Proposed Kimbe Resilient MPA Network

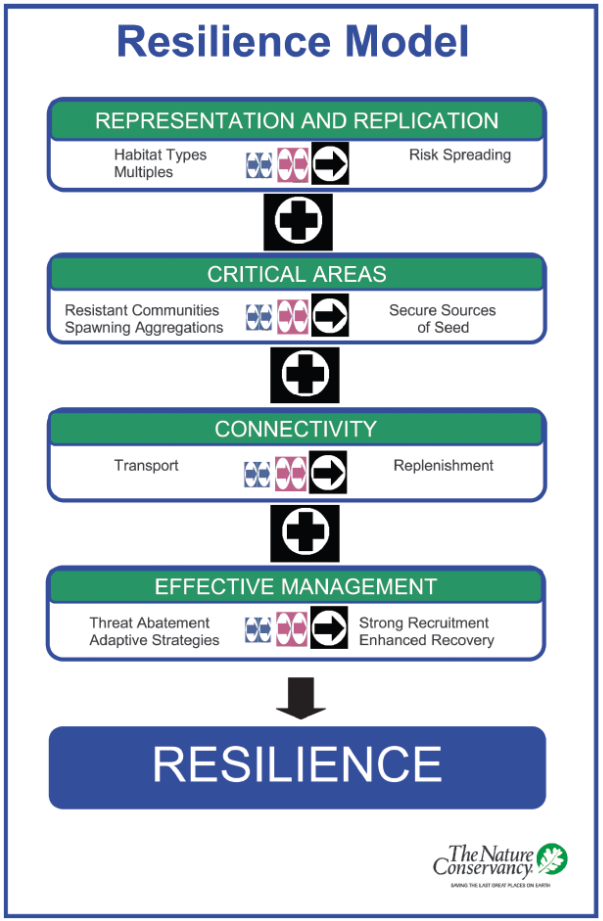


How best can communities "conserve" these Areas of Interest?

Leading to New Science Tools

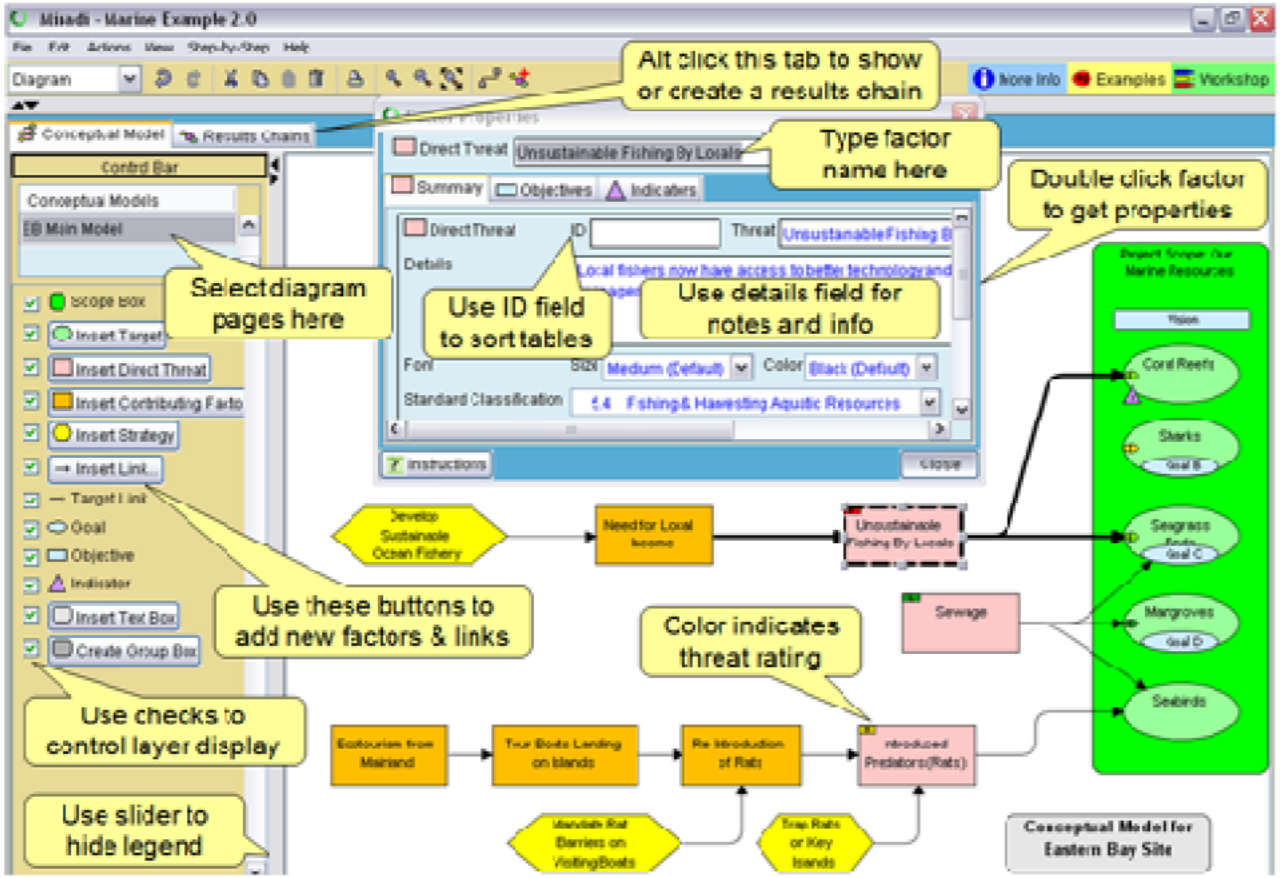
… and Management Theory

- Salm et al 2009. Coral Reefs and Climate Change: Science and Management, Coastal and Estuarine Studies 61: 207-222.



… and adaptive management systems

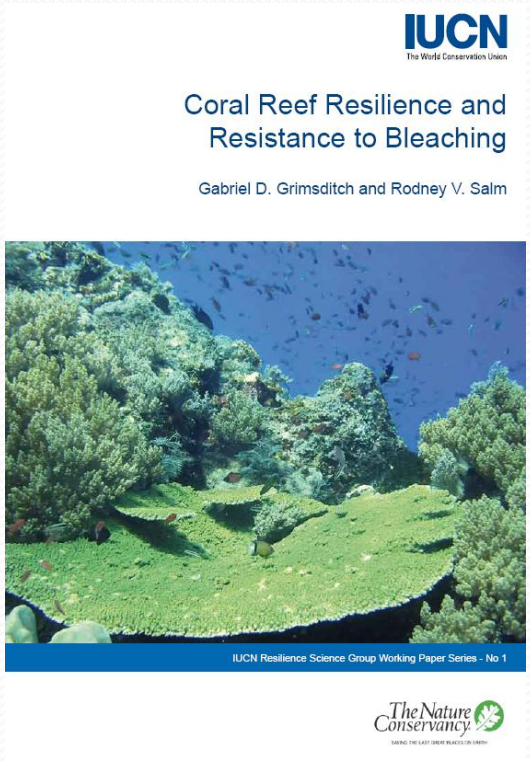
MIRADI™ Adaptive Management Software for Conservation Projects

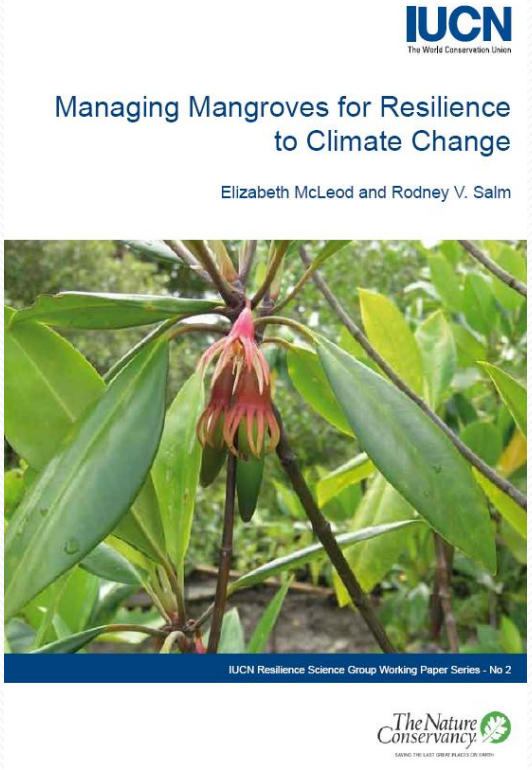


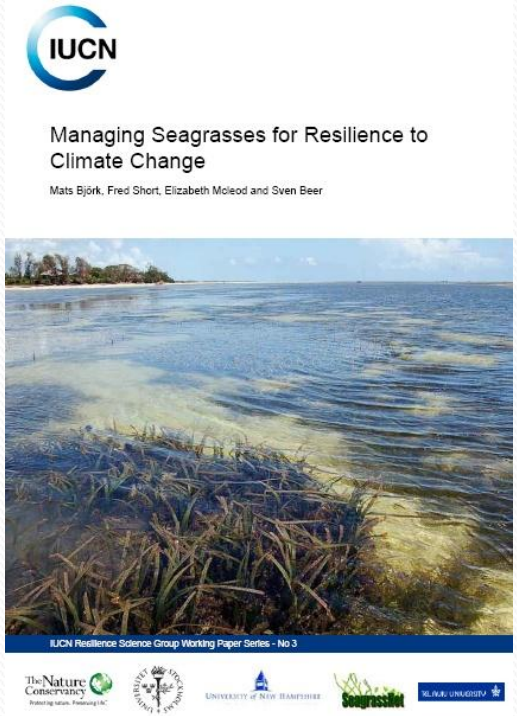
www.miradi.org

www.conservationmeasures.org

IUCN Resilience Series







Managing Mangroves for Resilience to Climate Change: 10 Strategies

1) Apply risk-spreading strategies to address the uncertainties of climate change.
2) Identify and protect critical areas that are naturally positioned to survive climate change.
3) Manage human stresses on mangroves.
4) Establish greenbelts and buffer zones to allow for mangrove migration in response to sea-level rise, and to reduce impacts from adjacent land-use practices.
5) Restore degraded areas that have demonstrated resistance or resilience to climate change.
6) Understand and preserve connectivity between mangroves and sources of freshwater and sediment, and between mangroves and their associated habitats like coral reefs and seagrasses.
7) Establish baseline data and monitor the response of mangroves to climate change.
8) Implement adaptive strategies to compensate for changes in species ranges and environmental conditions.
9) Develop alternative livelihoods for mangrove dependent communities as a means to reduce mangrove destruction.
10) Build partnerships with a variety of stakeholders to generate the necessary finances and support to respond to the impacts of climate change.

http://data.iucn.org/dbtw-wpd/edocs/2006-041.pdf

Managing Seagrasses for Resilience to Climate Change: 10 Strategies

a) Improve management to reduce human impacts and to maintain seagrasses in as healthy a condition as possible and so better able to resist or recover from stresses, including climate change. There is no substitute for effective management and good water quality to enhance seagrass resilience.

b) Develop baseline maps of seagrass meadows to allow for monitoring of changes in distribution and abundance.

c) Implement monitoring programmes (e.g. SeagrassNet) that provide feedback on the results of coastal management. If management strategies are not meeting their objectives, they need to be adapted to achieve their goals.

d) Identify and fully protect seagrass communities that are at low risk of succumbing to climate change and anthropogenic impacts because these seagrass communities will serve as refugia to help seed the recovery of damaged areas.

Managing Mangroves for Resilience to Climate Change: 10 Strategies

e) Reduce the risk of any seagrass communities being lost as a consequence of climate change impacts by protecting multiple samples of the full range of seagrass communities and from a wide geographical range.

f) Identify patterns of connectivity between seagrass beds and adjacent habitats, e.g. mangroves and coral reefs, to improve the design of marine protected area networks and allow for ecological linkages and shifts in species distribution.

g) Restore critical seagrass areas that are positioned to survive climate change impacts by eliminating the causative agents of their decline.

h) Raise awareness of the value and threats to seagrasses, ensuring that coastal zone management or land use policies and plans address potential impacts to seagrasses and implement codes of conduct for fishing and boat anchoring to reduce disturbances.

http://data.iucn.org/dbtw-wpd/edocs/2008-024.pdf

Small Island Developing States + CC

http://www.un.org/esa/dsd/dsd_aofw_sids/sids_cc.shtml

- SIDS have characteristics which make them especially vulnerable to the effects of climate change. These characteristics include their limited size, geographical dislocation, proneness to natural hazards and external shocks, high exposure of population and infrastructure and limited adaptive capacity.

- Both adaptation and mitigation measures are central to addressing the challenges posed by climate change in SIDS. Unfortunately, these measures are constrained by inadequate data, limited financial resources, and weak technical, human and institutional capacity.

- The IPCC Fourth Assessment Report, WGII on small islands recognized that in most cases SIDS have low adaptive capacity, and adaptation costs are high relative to gross domestic product (GDP). The IPCC 4-AR placed a 'very high confidence' level on the probability of negative impacts imposed by climate change and sea-level rise on water resources, vital infrastructure, settlements and facilities that support the livelihood of island communities; a 'high confidence' level on the negative impacts climate change on biodiversity, tourism, agriculture, coral reefs, fisheries and other marine-based resources; and 'medium' confidence level on the negative impacts on human health.

- The adverse effects of climate change and sea level rise represent some of the most immediate threats to the sustainable development of SIDS. **For certain low lying states in particular, climate change is becoming an issue of survival.**

Small Island Developing States

http://unfccc.int/files/adaptation/adverse_effects_and_response_measures_art_48/application/pdf/

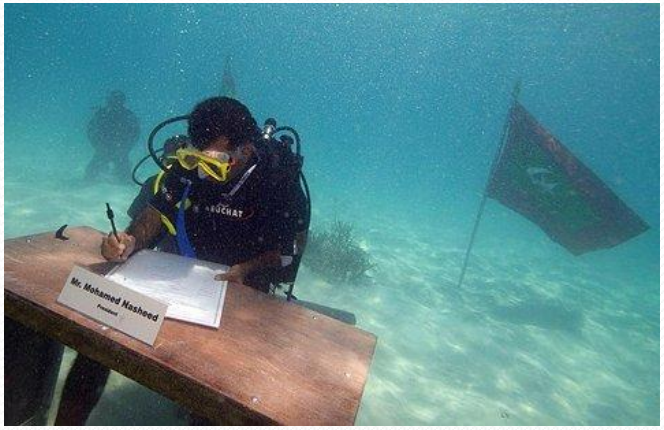
(a) **Surviving Climate Change in Small Islands, 2005**
This guidebook was prepared by the Tyndall Centre for Climate Change Research and Cayman Islands Department of Environment in collaboration with the United Kingdom Department for International Development and the United Kingdom Foreign and Commonwealth Office. The guide aims to inform government officers about climate change and the risks associated with its impacts and to provide 'ideas, tools and techniques' to take action to prepare for climate change
www.tyndall.ac.UK/publications/surviving.pdf

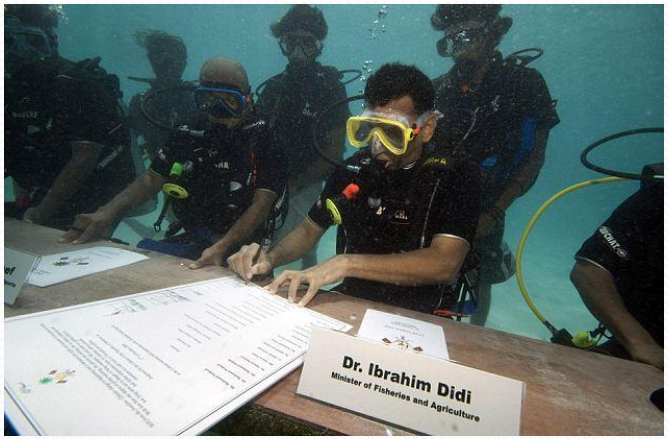
(b) **Climate Proofing: A Risk-based Approach to Adaptation, 2005**
Part of the Pacific Studies Series of the Asian Development Bank (ADB), this report was funded by the Canadian Cooperation Fund for Climate Change, administered by the ADB and the case studies were prepared by consultants. The case studies were based in the Federated States of Micronesia and the Cook Islands and aimed to highlight the range of levels at which adaptation takes place (from project to development planning) importance of mainstreaming adaptation .
www.adb.org/Documents/Reports/Climate-Proofing/main-report.asp

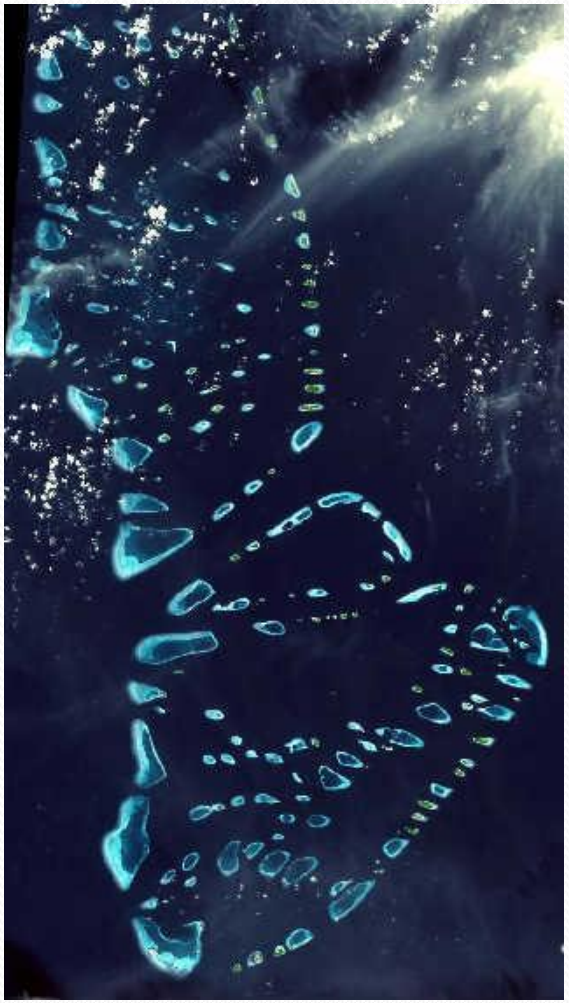
(c) **Climate variability and change and sea-level rise in the Pacific islands region, 2003**
This is a resource book funded by the Global Environment Bureau of the Japan Ministry of the Environment and published in collaboration with SPREP. Its target audience includes policymakers and decision makers, educators and other stakeholders
www.sprep.org.ws/climate/doc/01index.htm

(d) **Caribbean Risk Management Guidelines for Climate Change Adaptation Decision Making, 2003**
This book was produced by CARICOM as part of the Adapting to Climate Change in the Caribbean (ACCC) Project. The guidelines provide a user-friendly framework for risk management to assist the decision-making process when adapting to climate variability and climate change.

Maldives and CC







Island Vulnerability

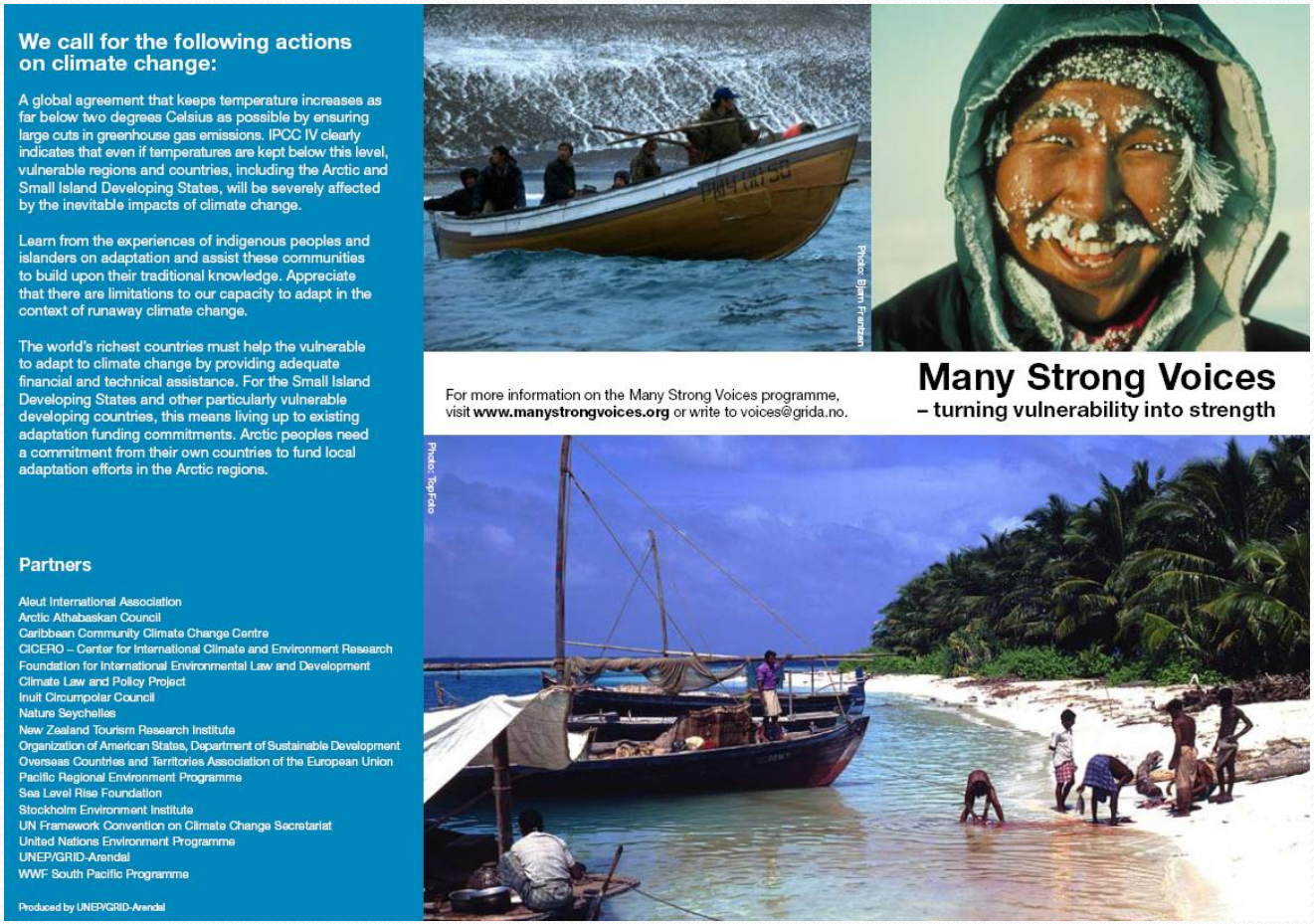
http://www.islandvulnerability.org/index.html

- Island Vulnerability explores the challenges which isolated geographies face when dealing with risk and disasters by examining the processes which create, maintain, and could be used to reduce their vulnerability.

- Biodiversity Limits on Small Islands
- Disaster Ecology for Pacific Islands
- Environmental Diplomacy
- EPIC: Early Participatory Intervention for Catastrophe to Reduce Island Vulnerability
- Island Affairs
- Island Anthology
- Island Dispersiveness Index
- Island Evacuation
- Managing Vulnerabilities of Small Island Heritage
- **Many Strong Voices**
- Regional Co-ordination of Island Vulnerability Reduction
- Unique Island Livelihoods
- Vulnerability Reduction for Island Museums
- Vulnerability Reduction in Border Regions

Many Strong Voices: Linking Islands and Arctic

http://www.manystrongvoices.org/



We call for the following actions on climate change:

A global agreement that keeps temperature increases as far below two degrees Celsius as possible by ensuring large cuts in greenhouse gas emissions. IPCC IV clearly indicates that even if temperatures are kept below this level, vulnerable regions and countries, including the Arctic and Small Island Developing States, will be severely affected by the inevitable impacts of climate change.

Learn from the experiences of indigenous peoples and islanders on adaptation and assist these communities to build upon their traditional knowledge. Appreciate that there are limitations to our capacity to adapt in the context of runaway climate change.

The world's richest countries must help the vulnerable to adapt to climate change by providing adequate financial and technical assistance. For the Small Island Developing States and other particularly vulnerable developing countries, this means living up to existing adaptation funding commitments. Arctic peoples need a commitment from their own countries to fund local adaptation efforts in the Arctic regions.

Partners

Aleut International Association
Arctic Athabaskan Council
Caribbean Community Climate Change Centre
CICERO – Center for International Climate and Environment Research
Foundation for International Environmental Law and Development
Climate Law and Policy Project
Inuit Circumpolar Council
Nature Seychelles
New Zealand Tourism Research Institute
Organization of American States, Department of Sustainable Development
Overseas Countries and Territories Association of the European Union
Pacific Regional Environment Programme
Sea Level Rise Foundation
Stockholm Environment Institute
UN Framework Convention on Climate Change Secretariat
United Nations Environment Programme
UNEP/GRID-Arendal
WWF South Pacific Programme

Produced by UNEP/GRID-Arendal

Photo: Bjørn Frantzen

For more information on the Many Strong Voices programme, visit **www.manystrongvoices.org** or write to voices@grida.no.

Many Strong Voices
– turning vulnerability into strength

Photo: TopFoto

Indigenous Knowledge

- **We offer to share with humanity our Traditional Knowledge, innovations, and practices relevant to climate change, provided our fundamental rights as intergenerational guardians of this knowledge are fully recognized and respected. We reiterate the urgent need for collective action.**

Agreed by consensus of the participants in the Indigenous Peoples' Global Summit on Climate Change, Anchorage Alaska, April 24th 2009

http://www.indigenoussummit.com/servlet/content/home.html

Global Islands Partnership (GLISPA)

http://www.cbd.int/island/glispa.shtml

Aim is to reduce significantly the rate of island biodiversity loss by 2010 and beyond as a contribution to poverty alleviation and the sustainable development of islands, particularly small island developing States.

Program of Work organized under seven focal areas:

1. Protect the components of biodiversity
2. Promote sustainable use
3. Address threats to biodiversity
4. Maintain goods and services from biodiversity to support human well-being
5. Protect traditional knowledge and practices
6. Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources
7. Ensure provision of adequate resources

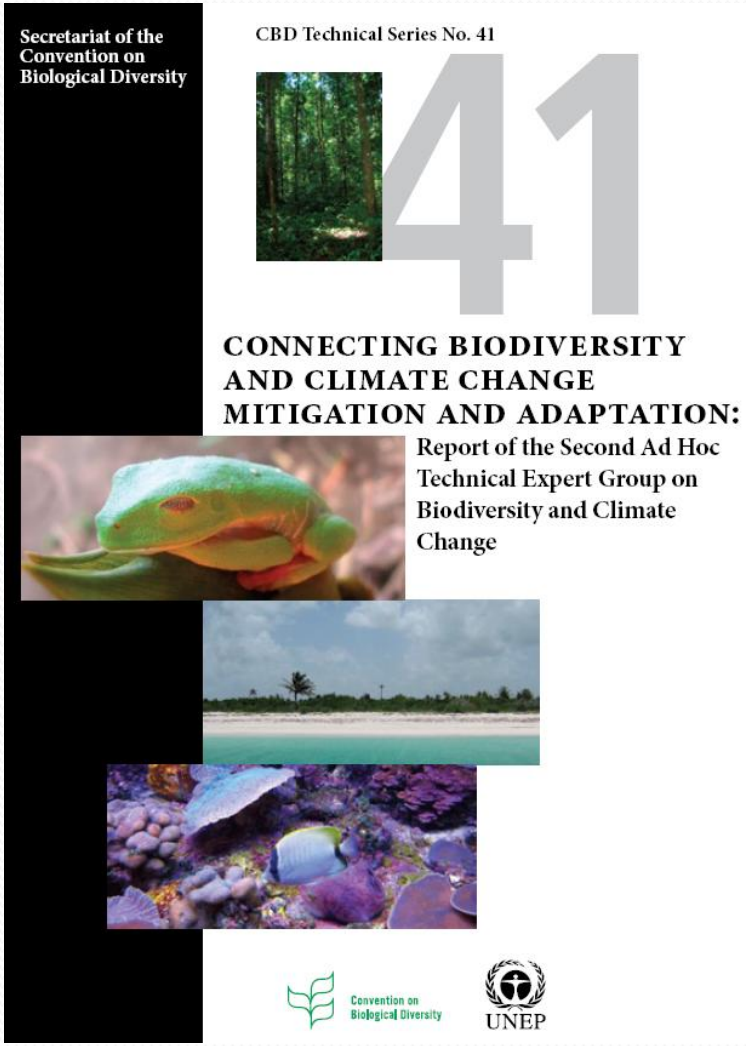
Convention on Biodiversity

http://www.cbd.int/climate/

2010 International Year of Biodiversity

A recent study in the United States valued the risk-reduction benefit provided by wetlands at $60,000 per acre for a single storm event, not including the value of other services provided.

Ahmed Djohghlaf, CBD Secretary
World Wetlands Day
2 February 2010



Foundation Principles and Strategies

Vulnerability

- 24. A key property of ecosystems that may be affected by climate change is the goods and services they provide.
- 26. The impacts of climate change on biodiversity will change human disease vectors and exposure.
- 29. Changes and shifts in the distribution of marine biodiversity resulting from climate change will have serious implications for fisheries.

Adaptation Response

- 67. The most fundamental biodiversity conservation strategy will continue to be promoting the conservation of intact and functioning ecosystems wherever possible.
- 70. In cases where there are existing barriers to migration, such as landscape fragmentation, or limits to dispersal capacity, assisted relocation, or migration, of species may be the only approach to ensure their persistence.

Table 1.1: Tools and methodologies used to estimate the components of vulnerability

Components of vulnerability	Tools and methodologies
Exposure[65]	Projections of changes in physical parameters (including CO_2 concentration; temperature, precipitation, extreme events, climate variability, sea levels, ocean acidification, sea surface temperature)
Sensitivity	Species level Bioclimatic models[66] Demographic models[67] Ecophysiological models[68] Population viability models[69]; estimates of threatened status (e.g. Red List status),[70] interactions and co-extinction models (e.g. pollination, predator-prey, competition, host-parasite),[71] dynamic vegetation models; Species-specific energy-mass balance models[72] life history and species trait analysis[73] Level of communities and ecosystems Earth system models;[74] projections of productivity; Dynamic vegetation models (including plant functional types)[75]; biogeochemical cycle models[76]; Hydrological, soil and moisture balance, coastal flooding models[77]; estimates of ecosystem health[78]; fire models[79]; trophic relationships[80]; state-transition models
Adaptive capacity	Genetic level Selection experiments;[81] experimental estimates of ecotypic variation of response[82] Species level Use of natural latitudinal or elevational gradients;[83] estimates of resilience and non-climatic stresses;[84] GIS: analysis of spatial habitat availability, PAs, corridors, barriers, topography; Bioclimatic models; Experimental manipulations of CO_2, water, temperature etc.;[85] translocation/transplant experiments;[86] responses to past or current climate variability;[87] responses to past climates[88] Assessments of current conservation status Ecosystem level Estimates of resilience and role of non-climatic stresses;[89] GIS: analysis of spatial habitat availability, PAs, corridors, barriers, topography; state-transition models; responses to past climates Assessments of current conservation status

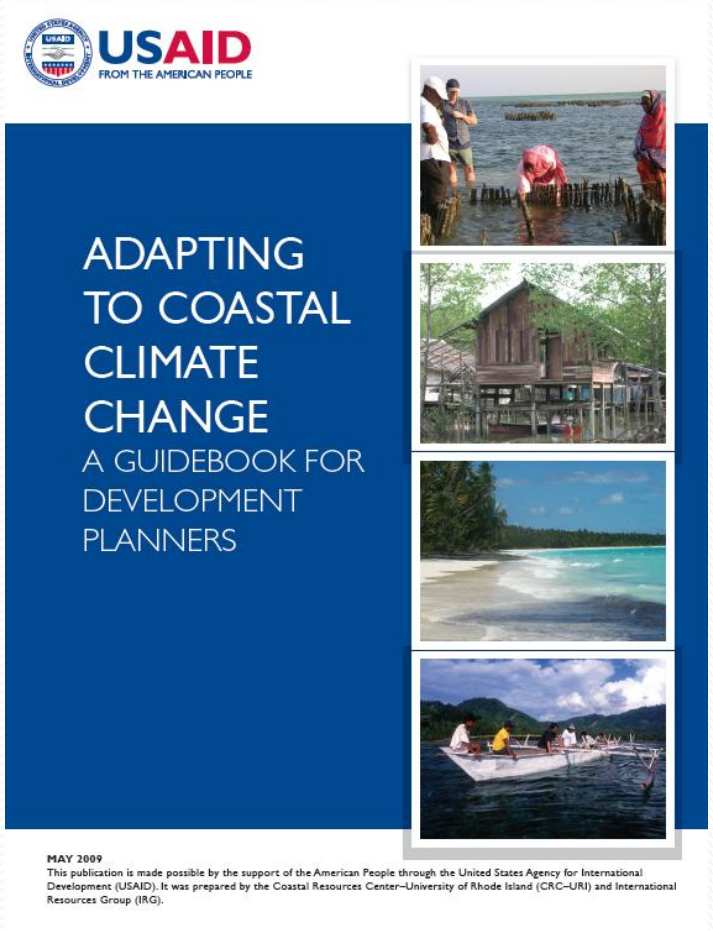
Table 2.1. Principles for adaptation activity planning and implementation

1. Establish objectives and define expected outcomes for adaptation activities	Objectives should describe: • How adaptation activities are intended to address the climate change impacts on the priority species and ecosystems. • Outcomes should be defined in measurable, time-bound terms so that the efficacy of adaptation activities can be evaluated.
2. Monitor, measure and evaluate the effectiveness of adaptation activities.	Monitoring practices should be designed to: • Verify that the intended objectives of adaptation activities are achieved. • Address uncertainty regarding the timing and magnitude of climate change impacts • Avoid mal-adaptation. • Indicators should be matched to the intended objectives and outcomes of the adaptation activities. • Indicators should be well-defined, practical and measurable so that they provide timely and relevant information. • The specific choice of indicators is flexible and should be tailored to the situation being evaluated.
3. Inform decision making by integrating traditional knowledge, scientific information and evidence about climate change impacts and the effectiveness of adaptation activities.	• A research agenda should be elaborated to address questions about the ecological, social and economic impacts of climate change. • Climate change and impact models are needed to improve the predictive capacity at spatial and temporal scales that are relevant to decision-makers and designers of adaptation activities. • Mechanisms for bringing together lessons learned and for facilitating knowledge transfer (e.g., the Ecosystems and Livelihood Adaptation Network; Nairobi Work Programme databases and Focal Point forum) should be encouraged.
4. Build and strengthen management and technical capacity for biodiversity protection and sustainable use of natural resource by involving local and indigenous communities.	• All relevant stakeholders, especially local and indigenous communities who may be most dependent on adaptation activities, should be involved in management decisions. • This requires robust management institutions that facilitate knowledge transfer (e.g., lessons learned, best practices) among communities, economic sectors, and the general public to ensure informed decision-making. • Appropriate training and capacity development needs to be ensured.

Table 2.3 Examples of ecosystem-based adaptation measures that provide co-benefits

Adaptation measure	Adaptive function	Co-benefits			
		Social and cultural	Economic	Biodiversity	Mitigation
Mangrove conservation	Protection against storm surges, sea-level rise and coastal inundation	Provision of employment options (fisheries and prawn cultivation) Contribution to food security	Generation of income to local communities through marketing of mangrove products (fish, dyes, medicines)	Conservation of species that live or breed in mangroves	Conservation of carbon stocks, both above and below-ground
Forest conservation and sustainable forest management	Maintenance of nutrient and water flow Prevention of land slides	Opportunities for Recreation Culture protection of indigenous peoples and local communities	Potential generation of income through: Ecotourism, Recreation Sustainable logging	Conservation of habitat for forest plant and animal species	Conservation of carbon stocks Reduction of emissions from deforestation degradation

Lots of Emerging Adaptation Guidance



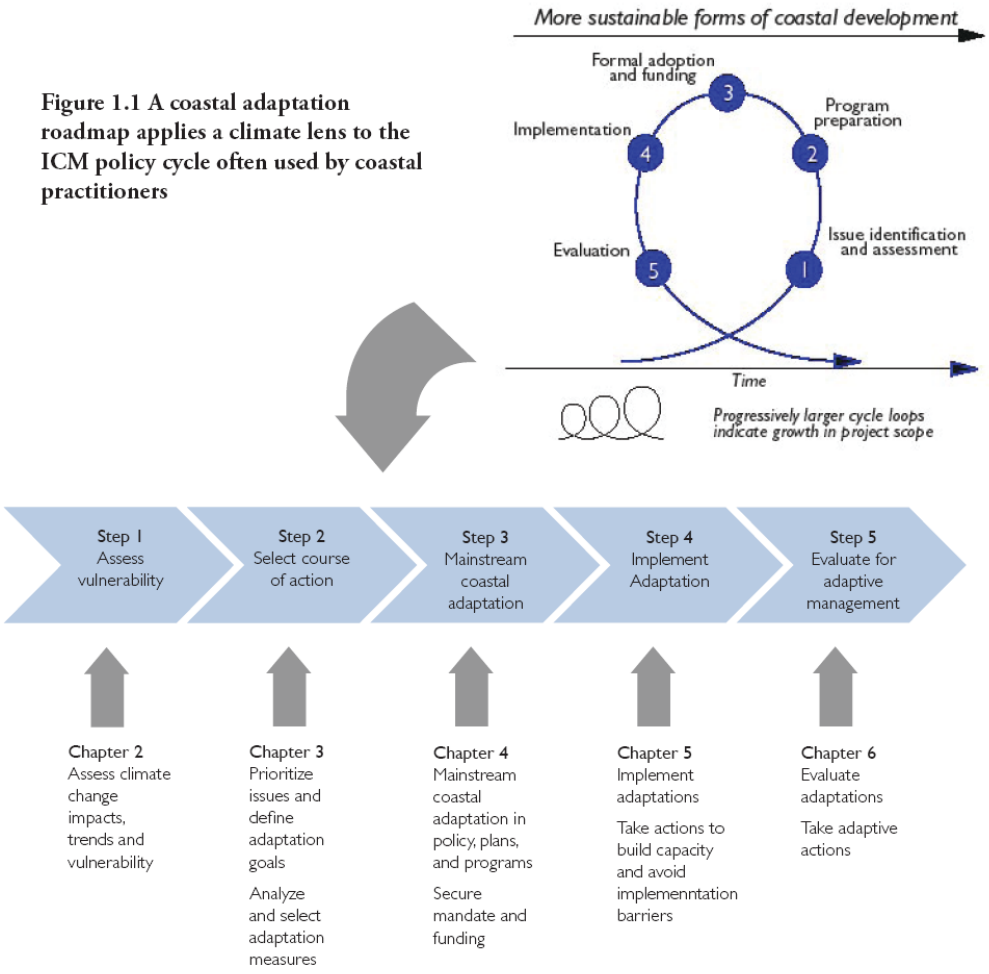
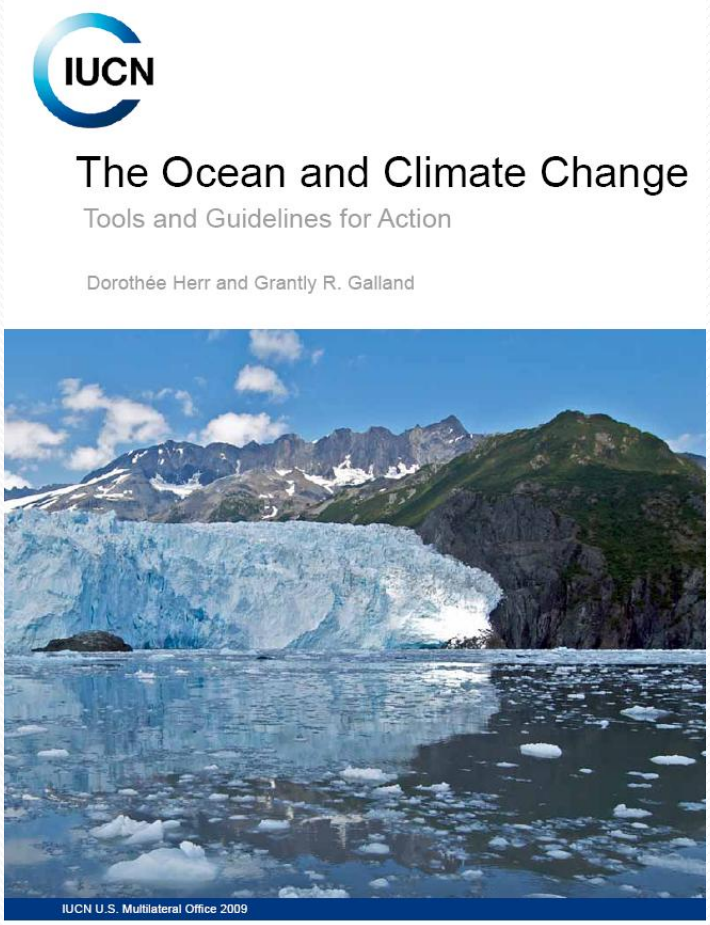


Figure 1.1 A coastal adaptation roadmap applies a climate lens to the ICM policy cycle often used by coastal practitioners

Global Guidelines that Merit Local Consideration – e.g. Migration



Improve the management of the environmental migration processes that are already happening.

Recognize that early action and planning are urgently needed and that reactive intervention is not sufficient.

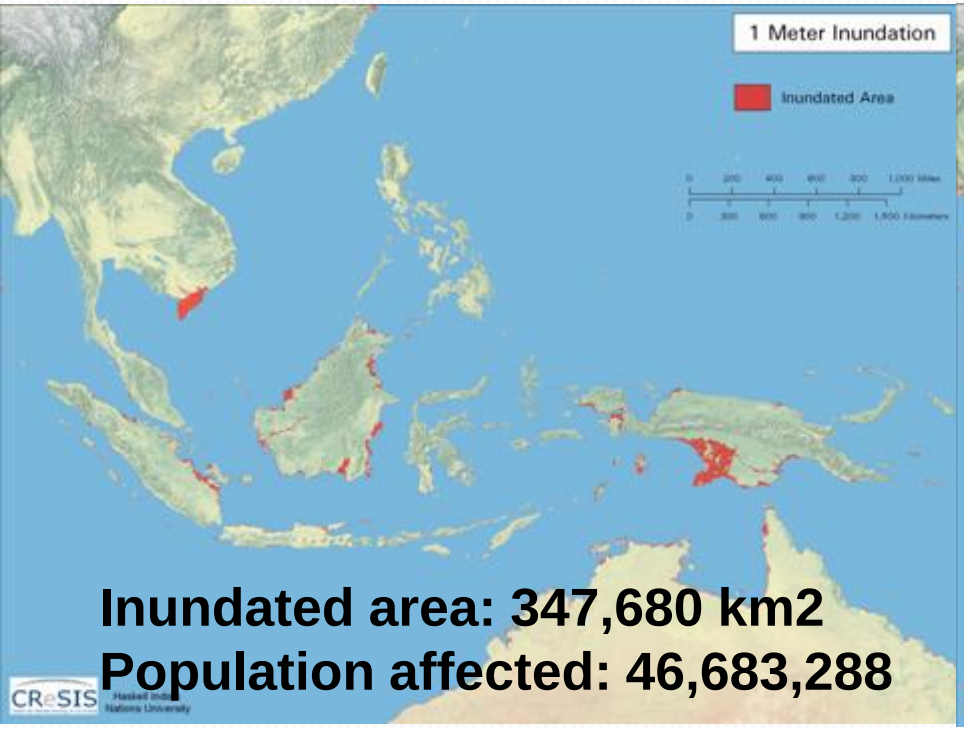
Expand the understanding and recognition of potential migration issues through better analysis, better data and better predictions.

Create remedies for national and cross border displacement and migration at both the national and international level.

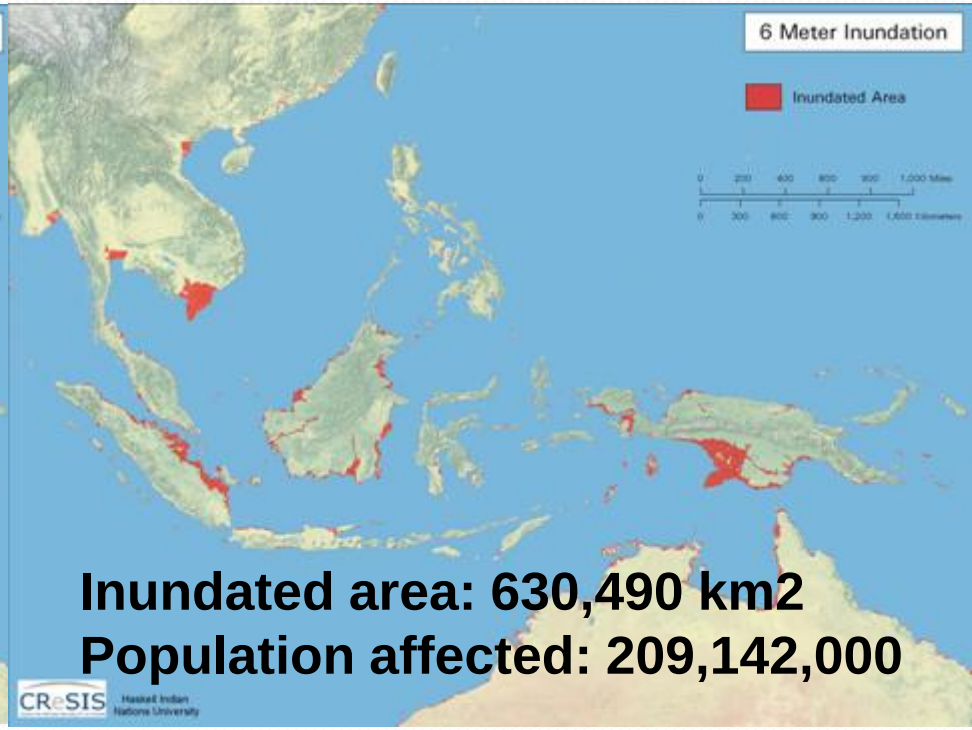
Incorporate human mobility – permanent and temporary, internal and cross border – into international and national climate change adaptation plans.

Implement a risk management strategy to protect citizens from climate change while concurrently assessing whether mitigation strategies should be abandoned in favor of evacuations.

SLR predictions suggest need for adaptation at unprecedented scales….



Inundated area: 347,680 km2
Population affected: 46,683,288



Inundated area: 630,490 km2
Population affected: 209,142,000

Ocean Acidification

IUCN

The Ocean and Climate Change

Tools and Guidelines for Action

Dorothée Herr and Grantly R. Galland

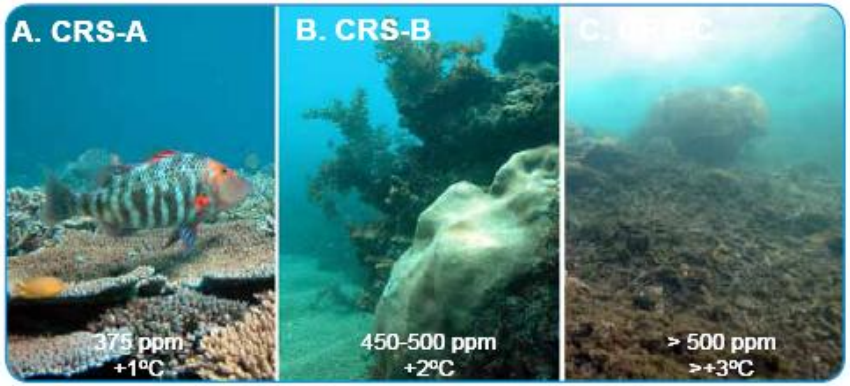


Fig. 2.3 Predicted scenarios for coral reefs under increasing amounts of atmospheric carbon dioxide. If concentrations of carbon dioxide remain at today's level, many coral dominated reefs will survive (left-hand panel) although there will be a compelling need to increase their protection from local factors such as deteriorating coastal water quality and overfishing. If carbon dioxide concentrations continue to rise as expected, reefs will become less dominated by corals and increasingly dominated by seaweeds (middle panel). If carbon dioxide levels continue to rise as we burn fossil fuels, coral reefs will disappear and will be replaced by crumbling mounds of eroding coral skeletons. In concert with the progression from left to right is the expectation that much of the enormous and largely unexplored biodiversity of coral reefs will disappear. This will almost certainly have major impacts on the tourist potential of coral reefs as well as their ability to support fisheries, both indigenous and industrial.

Reference: Hoegh-Guldberg et al. 2007

Ocean Acidification Adaptation, Research and Communication Workshop AMSS 18th January 2010*

- Ian M. Dutton, Alaska SeaLife Center and NPRB
- Jeremy Mathis, School of Fisheries and Ocean Sciences, UAF SFOS
- Nora Deans, NPRB + COSEE Alaska
- Marilyn Sigman, COSEE Alaska
- Molly McCammon, AOOS + COSEE Alaska

- Provide AMSS attendees with an overview of current knowledge of Ocean Acidification in the North Pacific
- Develop guidance for:
  a. Researchers (and research funders) on OA research priorities in Alaska
  b. Educators on OA communication best practices; and
  c. Managers and communities on OA adaptation principles and practices to test and learn from

* Report in progress – to be posted on http://www.coseealaska.net/

Ocean Acidification Adaptation, Research and Communication Workshop AMSS 18th January 2010*

How Might Fishers Adapt to increasing OA?

- Too early – we can't advise them yet?
- Need more data
- Think carefully about investments in fisheries – gear, geographies and effort
- Educate – don't panic!
- Keep talking with scientists
- Fishers should lobby for more political support for research
- More transparency in fisheries reporting
- Insist results from observing address OA
- Need to diversify economies more – more farming in AK?
- Help fishers to network/learn

* Report in progress – to be posted on http://www.coseealaska.net/

Fishing-Climate Synergy

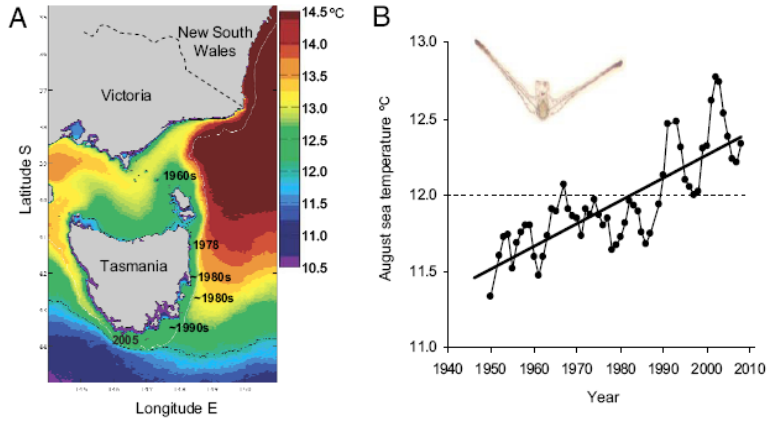


Fig. 1. Recent climate-driven range extension of the long-spined sea urchin to eastern Tasmania. (*A*) Sea surface temperature (SST) map of south eastern Australia showing influence of the warm East Australian Current in eastern Tasmania during Austral winter; data are mean SST (Pathfinder, 4 × 4 km pixels) for June–August 1993–2007. Dates show year of first observations of *Centrostephanus rodgersii* at sites on the Tasmanian coast. (*B*) Long-term winter warming trend of coastal waters in eastern Tasmania 1950–2008; data are 4 year running means (see *Materials and Methods*) for August, the month of major *C. rodgersii* spawning (15); dashed line indicates the lower temperature limit for the development of *C. rodgersii* larvae (15); inset shows 21-day-old *C. rodgersii* echinopluteus.

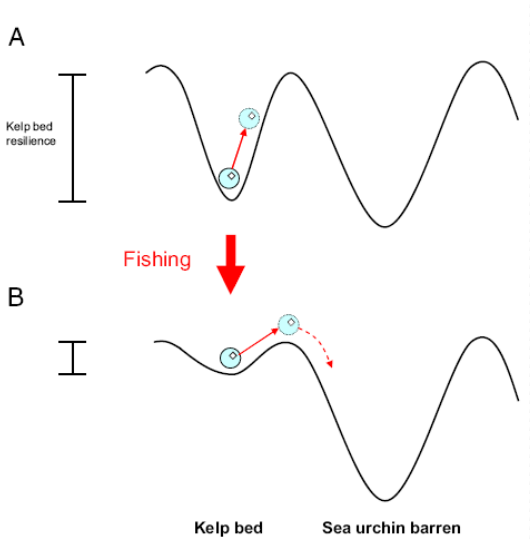


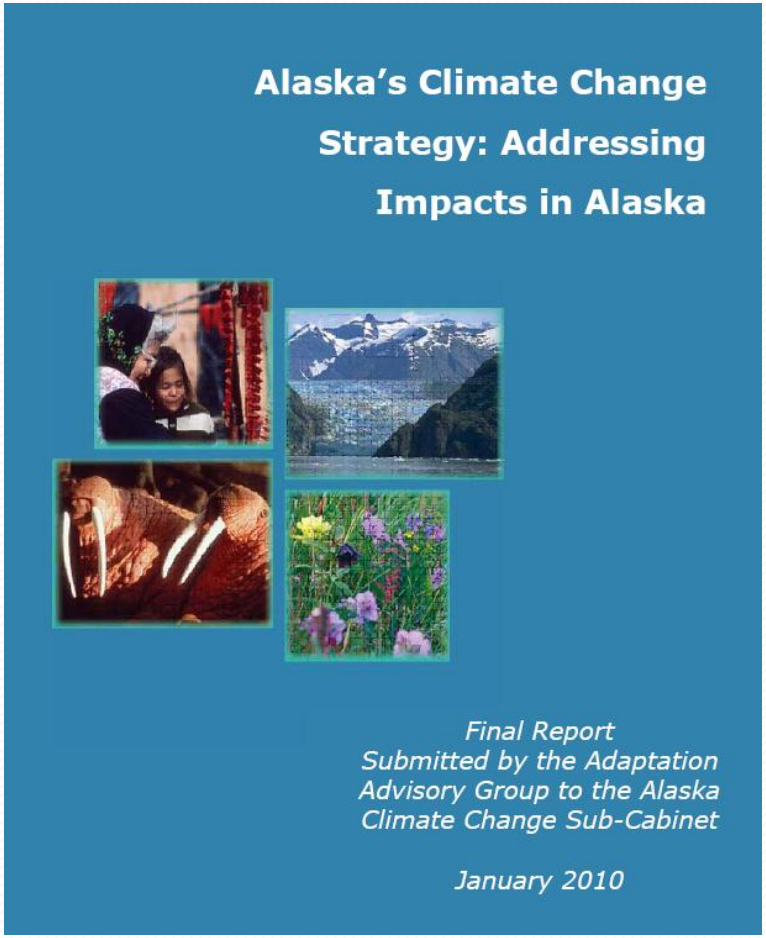
Fig. 4. Conceptualization of loss of kelp bed resilience because of fishing and associated increase in risk of catastrophic phase shift to the *Centrostephanus rodgersii* barrens state. Alternative basins of attraction represent kelp bed and sea urchin barrens states and the position of the ball represents ecosystem status. To shift to barrens habitat the kelp system must be perturbed sufficiently for the ball to roll from one basin to another (dashed arrow). (*A*) Prefished kelp bed with high abundance of large predatory lobsters and high resilience (indicated by basin depth). (*B*) Heavily fished kelp beds with shallow 'basin' and thus lower resilience. Solid arrows represent perturbation of the kelp bed state in the form of climate-driven incursion of *C. rodgersii*. The likelihood of catastrophic shift to sea urchin barrens depends on the size of the perturbation, which is the same in both (*A*) and (*B*), and the basin depth, i.e., ''resilience stability'' of the kelp-dominated state.

Ling et al 2010 - PNAS

AK CC Strategy Process

Climate change presents both potential impacts and opportunities for Alaskans and the Alaska economy…

…an adaptation strategy must recognize both the need for immediate action to address observed effects of climate change (in some cases) as well as the importance of developing a foundation of data, policies, and knowledge about adaptation strategies that will enable successful adaptation over the long term.



http://www.climatechange.alaska.gov/

Alaska SeaLife Center
windows to the sea

So What is ASLC Doing?

www.alaskasealife.org

Alaska SeaLife Center
windows to the sea

Promoting Public Understanding

- Engaging our members, staff and partners in regular dialogues (e.g. http://sealifeceo.blogspot.com/)
- Expanding our CC exhibits and interpretive programs to promote understanding and action (e.g. by tourism industry)
- Working with Alaskan NGOs, ACCAP, coastal communities, etc. to share knowledge and innovations
- Developing an implementing a CC K-12 CC curriculum (in partnership with COSEE, etc.)
- Expanding distance education offerings within Alaska and to lower 48 and globally
- Sharing knowledge with other aquaria (see http://www.aquariumsandclimate.com/) and Coastal America partnership (www.coastalamerica.org)

Building a Cohesive CC Research Agenda

Alaska SeaLife Center
windows to the sea

- Expanding our disciplinary coverage – new strategic plan in process
- Expanded links with climate researchers in UAF/other institutions and broader Science Advisory Committee
- Tightening our ongoing research links with CC monitoring and adaptation (e.g. glacier retreat impacts on harbor seals)
- Expanding our research repertoire (e.g. invasive species, ocean acidification food chain impacts, ice dependent species adaptation, etc.)
- Improving our research dissemination to promote public understanding and improve knowledge about adaptation options

Invasive Species Monitoring

Prince William Sound RCAC Regional Citizens' Advisory Council

Alaska Department of Fish and Game

Smithsonian Environmental Research Center

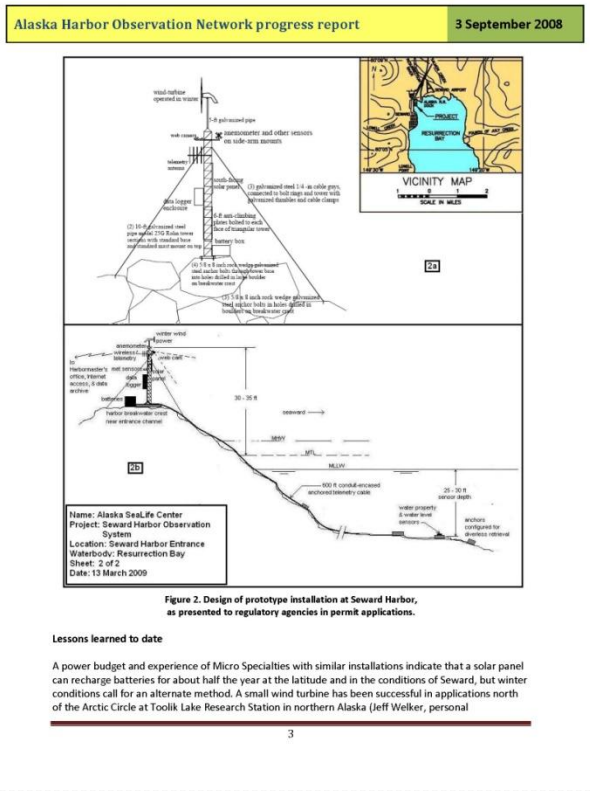
Alaska SeaLife Center
windows to the sea

Harbornet: Observing System

New partnership with UAA and AOOS

First Installation Seward

http://akHarborObs.net/Seward/



Alaska Harbor Observation Network progress report | 3 September 2008

Figure 2. Design of prototype installation at Seward Harbor, as presented to regulatory agencies in permit applications.

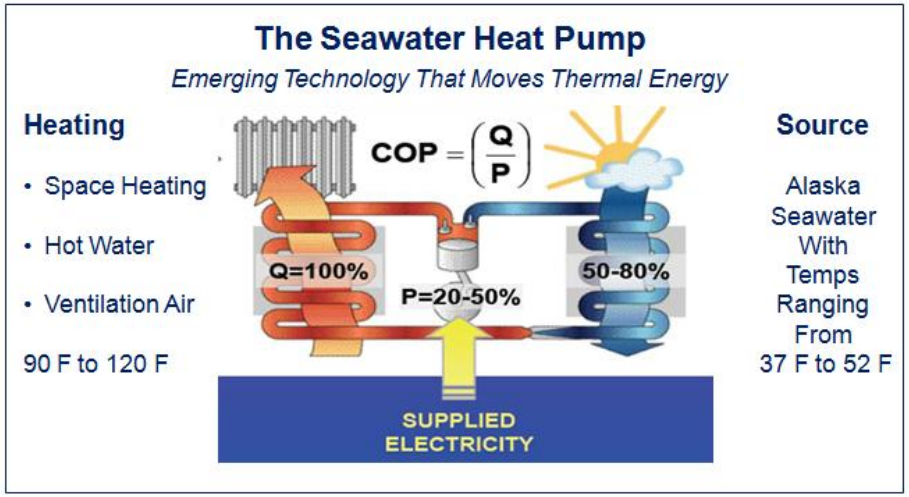
Lessons learned to date

A power budget and experience of Micro Specialties with similar installations indicate that a solar panel can recharge batteries for about half the year at the latitude and in the conditions of Seward, but winter conditions call for an alternate method. A small wind turbine has been successful in applications north of the Arctic Circle at Toolik Lake Research Station in northern Alaska (Jeff Welker, personal

3

Alaska SeaLife Center
windows to the sea

Walking the Talk – Seek to Demonstrate Sustainability in Everything we do



Summing Up – 3 key adaptation strategies for AK

- **Building Understanding** – promoting climate change literacy is critical need and must occur at every level and in every sector of Alaskan society – we have an obligation to future generations to facilitate the necessary understanding that must underpin sensible risk taking and proactive adaptation.

- **Communities of Practice (learning networks)**– a workable tool for sharing knowledge at community scale – internally and externally, vertically and laterally (see MIC example and AK Adaptation Strategy ct1 – AK Climate Change Knowledge Network)

- **Smarter Growth** – we must think long term (100 year+) and develop vision and mechanisms for adaptive development* in Alaska – Alaska needs a long term plan with built in adaptation strategies – Marine Spatial Planning offers new opportunities


ian_d@alaskasealife.org
http://sealifeceo.blogspot.com/
THANK YOU

Key Definitions

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic changes or their impacts, so as to reduce harm or exploit beneficial opportunities. *(IUCN)*

Vulnerability: indicates the potential for damage or harm to occur, yet vulnerability is not only about the present state, but also about what we have done to ourselves and to others over the long-term, why and how we have done that in order to reach the present state, and how we may change the present state to improve in the future. *(Island Vulnerability)*

Valuing Impacts of CC

- The World Bank estimated that coral reef degradation in Fiji attributable to climate change is expected to cost between US$ 5 million and US$ 14 million a year by 2050 due to the loss of value from fisheries, tourism and habitat.
- The loss in welfare associated with climate change in a mesic-Mediterranean landscape in Israel is estimated at US$ 51.5 million if conditions change to a Mediterranean climate, US$ 85.5 million if conditions change to a semi-arid landscape and US$ 107.6 million for conversion to an arid landscape based on loss grazing and willingness to pay.
- The lost value for protected areas associated with the projected impacts of climate change in Africa, based on willingness to pay, is estimated at US$ 74.5 million by 2100.
- The predicted negative impacts of climate change on coral reefs in the Bonaire National Marine Park in the Netherland Antilles, based on willingness to pay estimates by divers was US$ 45 per person per year if coral cover drops by from 35 per cent to 30 per cent and fish diversity drops from 300 species to 225 species and US$ 192 per person if coral cover drops from 35 per cent to 5 per cent and fish diversity drops from 300 species to 50 species.

Table 4.2: Instruments and incentives for implementing ecosystem-based adaptation

Instruments and incentives	Application to ecosystem-based adaptation
Financial (variety of market and non-market sources)	
Payment for ecosystem services (not tradable)	Payment to reward the ecosystem services to those who maintain the service (e.g., payments for watershed management)
Carbon finance	Payment for carbon storage (e.g., Clean Development Mechanism, voluntary carbon market)
Incentives related to REDD	Positive incentive on issues relating to reducing emissions from deforestation and forest degradation in developing countries.
Biodiversity-based mechanisms, such as biodiversity banking, biodiversity offset	Payment based on proxy indicators or surrogate of biodiversity (e.g., area of intact forest)
Debt-for-nature swaps	Cancellation of debt in exchange for the conservation of natural ecosystems (e.g., creation of protected areas in Costa Rica in return for debt relief)
Conservation trust funds	Funds for improving the management of/and ensuring conservation of protected areas (e.g.; Conservation Covenant)

Non-financial	
Definition of land tenure, and use planning and ownership and land use and management rights	Clarification of land tenure and rights, to enhance conservation, restoration and sustainable management of ecosystems
Public awareness and capacity building on ecosystem-based adaptation	Increased recognition of the value of ecosystem-based adaptation and its role in adaptation strategies, leading to increased implementation
Development, refinement and enforcement of legislation	Legislation that promotes the implementation of ecosystem-based adaptation and tools to ensure compliance; Legislation that promotes sustainable use of ecosystems or discourages mismanagement (e.g., protected area legislation, pesticide use regulations, water pollution laws)
Institutional strengthening and creation of partnerships	Provision of financial and human resources to relevant institutions and establishment of networks involving diverse stakeholders

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

Anticipatory adaptation – Adaptation that takes place before impacts of climate change are observed (also referred to as proactive adaptation).

Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems (also referred to as spontaneous adaptation).

Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.